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EDITA IUSSU SOCIETATUM RADIOLOGICARUM
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VOL. 37 JUNE 1952 FASC. 6

A METHOD OF TOPOGRAPHIC URETHROCYSTOGRAPHY IN WOMEN

by

Björn E. W. Nordenström

An ideal method of urethrocystography in women does not yet exist.

In 1930 THOMSEN (15) introduced two methods of roentgen visualization of the female urethra:

1. After the patient's bladder had been emptied by a catheter the whole urethral wall was smeared with a mushy suspension of bismuth or barium.

2. Injection of iodized oil in a retrograde direction during the radiographic exposures.

The films were made with the patient in the left and the right oblique positions.

In 1938 KENNEDY (6, 7) designed an apparatus for the radiography of a contrast-filled sac placed in the female urethra; the sac recorded the pressure of the urethral sphincter.

For the demonstration of movements of the female urethra during miction and rest, BALL (1) in 1950 introduced the term 'topographic urethrocystography'. He studied the movements of the bladder-neck in lateral projections (2), for which purpose the bladder was filled with a 5 per cent solution of sodium iodide. Visualization of the urethra was obtained by blocking the internal meatus by a Foley catheter, the external meatus being then blocked by a metal ring. A 30 per cent solution of sodium iodide was introduced between the obstructions produced. The movements of the bladder-neck were studied in geometric relationship to the symphysis pubis in continent and incontinent women.

Most methods reveal that the main problem of the moment lies in connection with the contrast medium.

Submitted for publication, Jan. 18, 1952.

From the Roentgen Department (Director: BENGT HOLMGREN) Sabbatsbergs Hospital, Stockholm, Sweden.

Fig. 1. The patient is examined standing. A nylon bag is tied up between the thighs.

Within recent times, thorotrast has been recommended for urethrocystography (14). Most authors have however abandoned the use of this substance (11). A case of spindle-cell sarcoma of the kidney 16 years after thorotrast pyelography has recently been reported (17).

For simple cystography the usual organic iodine compounds used for this purpose are sufficient. Urethrograms can be obtained by employing them with the patient in the oblique positions. The use of a 10 per cent suspension of barium sulphate is also recommended for cystography (3).

For the accurate estimation of the topography of the bladder and urethra, lateral and antero-posterior urethrocystograms are of fundamental importance. For lateral urethrography, however, considerable opacity of the contrast is necessary. For this reason different contrast compounds have been tested with regard to their suitability for lateral urethrograms. A suspension of barium in sterile water has given the best results. It makes lateral films of the female urethra during miction possible.

Procedure

A barium sulphate emulsion in the proportion of 1 : 3 parts by weight is boiled for fifteen minutes with water; the suspension is cooled to body-temperature.

The bladder is emptied and the contrast slowly injected through a catheter until the patient feels a desire to micturate. In cases of neurogenic disturbance of the sensitivity of the bladder about 200 ml of the contrast may be injected. The catheter is removed. A small indicator is held immediately above the external meatus by adhesive tape; a cm-indicator is then placed in a sagittal plane below the external meatus for direct measurements on the lateral films.

A nylon bag is tied between the thighs of the patient.

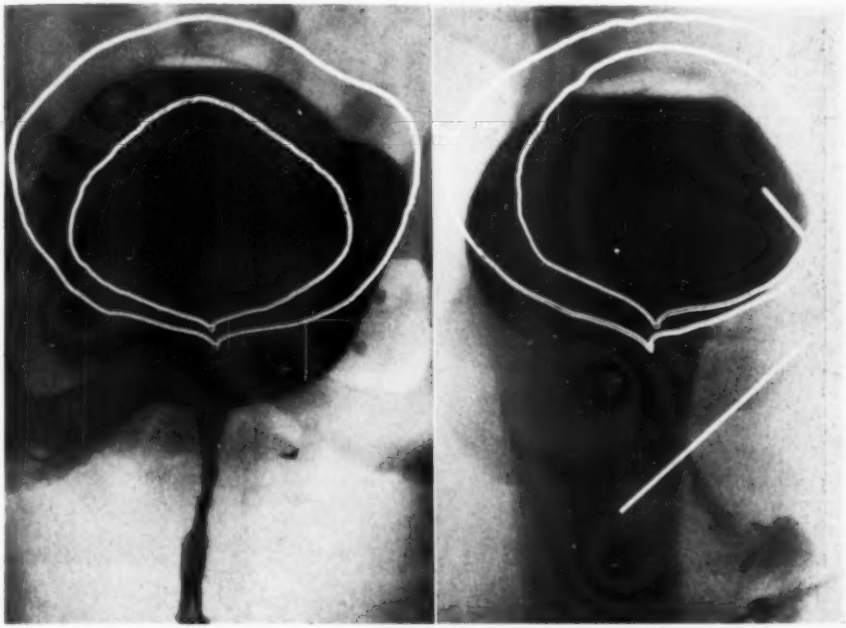


Fig. 2. The positions of the bladder during 'rest', 'miction' and 'hold' in antero-posterior and lateral projections. Continent nullipara.

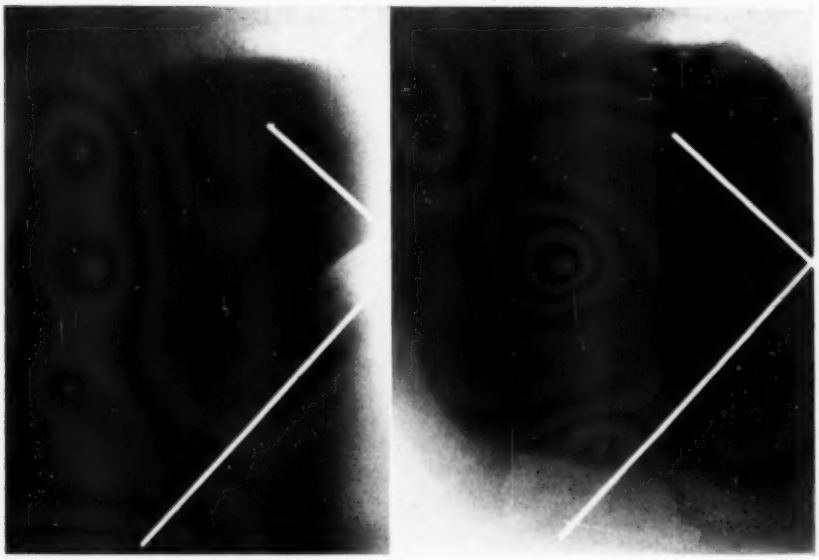
The patient is examined in the antero-posterior and lateral positions, standing, with the legs apart. The cm-indicator is removed when the patient is examined antero-posteriorly.

Exposures are made in 'rest', 'miction' and 'hold'. For patients who have difficulty in micturating in a standing position it is often possible to obtain miction films with the patient sitting. If she be unable to micturate, views during straining are obtained.

It is of importance that the patient should gain the impression that plenty of time has been reserved for the investigation; it is also preferable that the room be dark and silent.

After the miction films have been taken the mucosa of the bladder may be investigated. A catheter is introduced into the bladder and air injected; good double contrast pictures of the bladder mucosa are thus usually obtained.

After the investigation the bladder is thoroughly washed out with sterile water at body temperature.



a. b.

Fig. 3. Lateral urethrocystograms of a patient standing (3 a), and sitting (3 b).

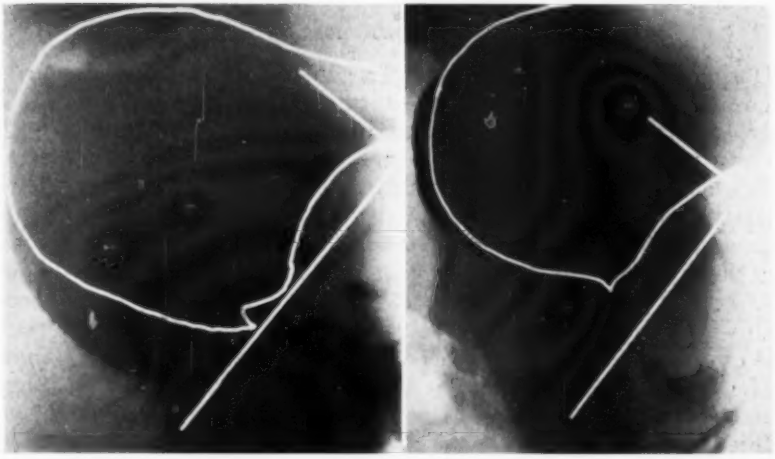
The Radiographs

The lateral films in 'rest', 'miction' and 'hold' are usually of greatest interest.

It is naturally advisable not only to measure various distances between anatomical points seen on the lateral urethrocystogram, but consideration should also be given to the clinical findings in the interpretation of the films. For this purpose intimate co-operation between the urologist and the roentgenologist is necessary.

For the topographic study of the bladder-neck BALL draws a line through the middle of the symphysis pubis on the lateral film. He then traces the inferior border of the symphysis pubis by following its ventral and dorsal margins and the anterior and posterior margins of both inferior pubic rami as far as they can be traced. This tracing of the inferior border of the symphysis is often difficult; a modification of the technique has therefore been introduced:

A line is drawn on the lateral film through the middle of the symphysis pubis. This line crosses the always sharply delineated upper border of the symphysis. It is possible to use this point as the origin of a co-ordinate system in which one co-ordinate is formed by the line through



a. b.

Fig. 4. Displacement of the bladder of an incontinent woman during 'rest' and 'miction' (4 a). Following plastic repair of the pelvic floor the bladder base is elevated cranially and ventrally (4 b).

the symphysis; it is thus possible to give an exact topographic definition of anatomical details seen on the lateral radiograph.

The films of a patient (nullipara) investigated by this method are shown in fig. 2.

The outlines of the bladder and internal meatus during 'rest', 'miction' and 'hold' are shown. It is interesting to note that the bladder not only moves caudally, but also in a dorsal direction during miction. The bladder base is well elevated.

Fig. 3 are films of an obese woman investigated standing and sitting. They demonstrate the possibility of obtaining lateral views of the urethra in fat subjects in the sitting position. It is sometimes difficult to recognize the symphysis pubis in this posture owing to the density of the thighs. This position is therefore used only if the patient has difficulty to micturate standing. Our experience up to now of this position and of its influence upon the topography of the bladder and urethra is not great. Any significant influence of the standing or sitting postures upon the topography of the bladder base is not seen in this case.

Displacement of the bladder in a caudal and dorsal direction in 'rest' and 'miction' is shown in fig. 4 a. The same case after plastic repair of the pelvic floor (INGELMAN-SUNDBERG method — 4, 5) is seen in fig. 4 b. The bladder is elevated in a cranial and ventral direction after the operation.

Discussion

During the retrograde injection of a contrast medium into the urethra of the male, a venous reflux of the medium is sometimes observed. This complication may be due to lesions of the urethral mucosa caused by previously performed catheterizations. 'Fausse routes' of the female urethra are not common. The risk of venous backflow of the barium contrast in the female urethra, after its injection through a soft rubber catheter inserted into the bladder, seems to be small. Any venous reflux from the urethra or the bladder has not been observed up to now.

After the bladder has been washed out with sterile water there is usually no barium to be seen cystoscopically; this can naturally not exclude the retention of small traces of the medium in crypts of the mucosa.

The possibility of the formation of concrements by small traces of barium in the bladder or ureters has therefore been considered.

Injection of barium media into the bladder has been previously carried out. WALLDÉN (16) injected a barium suspension and air in 40 cases in his investigations on the roentgen diagnosis of space-occupying processes in the small pelvis.

No complications arose in these cases (8). Nor have we seen any complications among 50 incontinent women after the injection of barium contrast into the bladder over a period of observation of a year.

If, however, calculi should form in any case in the future, they will be of less importance than the advantages of precise diagnosis in the often invalidating condition of female incontinence.

SUMMARY

A method of topographic urethrocystography in women is described. Following the introduction of a barium suspension into the bladder, lateral films of the bladder and urethra during micturition permit of a diagnosis as exact as in males. The topography of the bladder and the urethra as shown in these projections is related to a co-ordinate system.

ZUSAMMENFASSUNG

Es wird eine Methode der topographischen Urethrocystographie bei der Frau beschrieben. Nach Injektion von Barium-Kontrastmittel in die Blase ist est möglich, seitliche Bilder der Blase und der Urethra während Miction zu erhalten. Die Topographie der Blase und der Urethra sind auf den seitlichen Bildern zu einem koordinierten System verbunden.

RÉSUMÉ

Une méthode de l'urétrocystographie topographique de la femme est décrite. Après injection d'un contraste de barium dans la vessie, il est possible d'obtenir des images latérales de la vessie et de l'urètre pendant la miction. La topographie de la vessie et de l'urètre sont jointes à un système coordiné sur l'image latérale.

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SOFT-TISSUE RADIOGRAPHY OF THE PLACENTA

by

Carl F. Qvist

Placenta prævia (pl. p.) is the most serious cause of painless vaginal bleeding during the latter months of pregnancy. Since the clinical methods (digital examination) used to make the diagnosis, involve a marked risk of producing profuse bleeding, various roentgenological methods have been suggested to prove or disprove the presence of the condition and to determine the placental site.

In 1930 MENEES, MILLER and HOLLY suggested amniography as a means of determining the placental position. They injected a solution of strontium iodide into the amniotic sac through the abdominal wall after which they were able to identify the placenta as a filling defect at the border of the uterine shadow. In the hands of other workers (KERR & KACKAY), however, strontium seemed to have a deleterious effect on the foetus and was substituted by Uroselectan B which according to BURKE (1935) has no ill-effects on either mother or child. The drawback of this method was that in most cases it induced labour, and now seems to have fallen into disuse.

In 1932 is was shown by ERHARDT that the placenta could be demonstrated roentgenologically in mice following the intravenous injection of thorium dioxide — thorium being retained by the reticuloendothelial cells; at the same time, the liver and spleen were distinctly visualized. In place of radioactive thorium ERHARDT tried Degwitz' newly-discovered iodosol (tri-iodo-stearic acid) which gave a satisfactory opaque shadow of the placenta in animal experiments. OLSSON (1941) pointed out certain secondary effects of this agent which make it inapplicable in routine examinations and the method has found no place in obstetrical diagnosis.

Submitted for publication, Dec. 22, 1951.

In 1935 UDE & URNER suggested cystography as an aid in diagnosing pl. p. This procedure consists in measuring the distance between the upper border of the shadow of the urinary bladder and the part of the foetus (the head) presenting. The emptied bladder is injected with 40 cc of radiopaque medium. The patient lies in the horizontal position, the central ray being directed through the symphysis pubis. In cephalic presentations, the gap between the foetal skull and the shadow of the urinary bladder represents the foetal scalp, the amnion, uterine wall, peritoneum, and bladder wall. This gap, which is fairly constant, is stated to range from 0.8 to 1.5 cm (UDE & URNER). Others (PRENTISS & TUCKER) have reported it as varying between 0.8 to 2.1 cm. In the case of pl. p. the placenta is interposed between the foetal head and the bladder, thus increasing the gap. In Denmark, EKKERT PETERSEN was the first to publish the results of this method. BJERRE (1940) has stressed the importance of repeated examinations, both in the erect posture, and with manual compression of the foetal head into the pelvis. In BJERRE's opinion the foetal head/bladder separation must amount to a minimum of 2 cm for a diagnosis of pl. p. Since then, numerous workers (in Scandinavia, int. al. FROSTAD) have reported their results.

In 1941 BALL & GOLDEN described a simple way of diagnosing pl. p. It is based on the fact that towards the end of pregnancy, the foetal head will dip into the pelvic inlet and occupy the mid-coronal and mid-sagittal plane, when the mother is standing. If the head was displaced more than one-third of its diameter from this position, when the mother was standing erect, BALL & GOLDEN interpreted the condition as pl. p., provided that other space-filling processes (such as fibroma, ovarian cysts, distended bladder or rectum) could be ruled out. True, this method is applicable only in cephalic presentations, which means in 95 % of all cases. In a comprehensive study REID, in 1949, elaborated this diagnostic procedure.

For the sake of completeness, it is worth mentioning that in 1948 HARTNETT demonstrated that the placental position may be determined by aortography which affords filling of the maternal part of the placenta. They had tried the method on 68 patients without serious complications.

Soft-Tissue Radiography of the Placenta

SNOW & POWEL, in 1934, reported that the placenta could be seen as a soft-tissue shadow in lateral views of the pregnant abdomen. In 1939 SNOW & ROSENSOHN gave the results of further investigations but in cases of doubt they supplemented the method by antero-posterior and lateral films of the true pelvis following injection of air into the

Fig. 1. Lateral view of abdomen. Placental shadow in ventral upper uterine segment.

bladder and also, in some cases, into the rectum. DIPPEL & BROWN, in 1940, presented the results of the examinations of 262 patients. In 90 % of these cases the placental site was determined exclusively by soft-tissue radiography. In order to exclude pl. p. DIPPEL & BROWN demand that the whole of the placenta be visualized above the level of the iliac crests. Later, other workers have reported their experience with the method, employed alone or in combination with cystography (SOHRNE, BALIN & LAMBETH, BISHOP, REID and others). Most of these authors are satisfied with the results, claiming to be able to determine the placental position in about 90 % of all cases. The only serious criticism was advanced by MOIR in 1944. In clear but highly polemic form, he pointed out several sources of error which in his opinion had been overlooked or given too little attention by previous authors. The most serious of his objections have been rebutted by DIPPEL and later by REID. MOIR himself (in a private communication to the author) has stated that his criticism did not aim at denouncing the method but only at pointing out its sources of error.

A lateral view of the pregnant abdomen obtained with a suitable quality of radiation (soft rays) shows: (1) the maternal skin, (2) the abdominal muscles, (3) the uterine wall, (4) the foetal subcutaneous fat, and (5) the deeper foetal structures. Since the radiographic density of the anterior and posterior parts of the abdomen differs appreciably, it is difficult to visualize the anterior and posterior uterine walls on the same film. An attempt has been made to overcome this difficulty, int. al. by the procedure employed by DIPPEL of using a variable illuminator to view the films or by REID's method of using an aluminium filter to shield the anterior part of the abdomen more than the posterior part during the exposure.

Such a film usually shows how the thickness of the uterine wall, which according to DIPPEL & BROWN averages 1.24 cm and according to REID 1.3 cm, increases towards the ventral or dorsal aspect and forms an almost semilunar shadow demarcated by a darker line towards the middle of the uterus (Figs. 1 and 2). As a rule, this semilunar shadow occupies about one-third of the periphery of the uterine wall, its length is about 20—25 cm and its average thickness, according to SNOW, about

Fig. 2. Placental shadow in dorsal upper uterine segment.

7 cm (according to REID 5.6 cm). The shadow is made up of (1) the uterine wall, (2) the amniotic fluid, and (3) the placenta. The radiographic density of all three parts is identical as shown so aptly by MOIR. The dark line forming the foetal demarcation of the »placental shadow» and which represents the foetal subcutaneous fat, varies in thickness from a few mm to 1 cm (at the level of the foetal buttocks). The placental shadow often shows impressions of the foetal limbs. Originally, SNOW thought that these impressions were situated in the placenta proper, but they are now interpreted as defects in the amniotic fluid surrounding the foetal limbs. As a rule, the placental implantation is on the anterior or posterior wall of the fundus, less commonly in the lower uterine segment. If the placental shadow is not distinctly visualized in true lateral views, it may often be clearly visible in oblique views (Fig. 3).

The fact that the placental shadow measures 5.6 cm (REID), while the placenta proper *in situ* measures only 2—3 cm, will be understood when consideration is taken of the fact that the shadow represents not only the placenta, but also the uterine wall and the amniotic fluid. Those who have seen the placental shadow a few times are not likely

Fig. 3. Second oblique position. Placental shadow in upper uterine segment.

to mistake it. One must be sure, however, that the shadow is of the above-mentioned shape and size, and not be misled by local accumulations of amniotic fluid filling up indentations on the foetal surface and visible most commonly and most distinctly at the level of the occipital groove.

It may sometimes be difficult or impossible to discern the placental shadow; it may be very hard in hydramnios, for instance, because of the abundance of amniotic fluid; in twin pregnancy it may be difficult to determine the position of both placentas. A fibroma may be present although not likely to be mistaken for the placental shadow. In addition, the possibility of placenta bipartita and placenta spuria must always be borne in mind.

In cases of premature separation of the placenta the shadow will be of increased thickness due to retroplacental hæmatoma. In some

cases, moreover, the uterus has shown a regular »bulge» at the level of the hæmatoma.

Writer's Investigations

At the Roentgen Department of the Aalborg Municipal Hospital, patients suspected of pl. p. have previously been examined exclusively by the cystographic method. We have however in a series of 52 cases tried direct visualization of the placenta and experiences gained from this material will shortly be reported. The patients are examined, on the average, in the 38th week of pregnancy. Four of our patients were referred to the department because of vaginal bleeding, whereas the remainder were referred for roentgen examination for other reasons or examined in order to afford some experience in this diagnostic procedure. All except two were admitted at term, but a large number had been examined as out-patients before admission. Information about the course of labour in the 2 out-patients cases was obtained from their private physicians.

In the majority of cases we made a plain antero-posterior film and, in addition, a lateral view to show the soft parts. If the first lateral view did not give a satisfactory survey of the fundus or if it did not visualize the placenta distinctly, the examination was supplemented by more exposed — in some cases less exposed — films, in a few instances supplemented by oblique projections.

In 51 out of the 52 cases we could determine the placental position; in 50 cases it was directly visible. In one instance the placental shadow was not visible, but cystography by the method of Ude & Urner showed total pl. p., confirmed at Caesarean section. In another case the placental shadow could not be seen with certainty. This proved to be a case of hydramnios without clinical signs of pl. p.; delivery was normal.

In the remaining 50 cases the placental implantation was as follows: In the upper dorsal uterine segment in 27, in the upper ventral segment in 19, and in the lower ventral segment in 4; implantation in the lower dorsal uterine segment did not occur. Two of the patients with signs of implantation in the lower ventral uterine segment and with clinical signs also giving rise to suspicions of pl. p., were submitted to cystography which showed nothing abnormal. Delivery was normal in all 4 cases of this group.

On the average, the placental shadow measured 5.6 cm, corresponding to the measurement reported by Reid. The minimum was 3 cm and the maximum 9.5 cm. Clinical confirmation of the placental site was

available in 5 cases, by Caesarean section in 3, and by manual removal of the placenta in 2. Manual removal of the placenta was performed in an additional case, but unfortunately no note was made of its position.

In 2 cases there was a question of premature separation of the placenta; the placental shadow was very thick, measuring 9 and 9.5 cm respectively. No »bulge» of the uterus was observed.

Among the remaining cases, 4 were delivered by forceps and in 2 the membranes were ruptured, whereas the remainder were delivered spontaneously; in all these cases the placenta was complete.

In the 38 cases of cephalic presentation in which antero-posterior and lateral films are available, the head was centrally situated in the pelvis in 36, whereas in two cases it was displaced (in both cases about 2 cm and in the midcoronal plane). One of these cases was that of total pl. p. but in the other delivery was normal. In the latter case, we are unable to advance any explanation of the displacement, but the patient was not examined for the other causes which may give rise to displacement. Other presentations were as follows: cephalic 9, breech 3, and transverse 2.

We had one twin pregnancy in our series; only one placenta implanted on the posterior wall of the fundus, could be discerned with certainty. The implantation was confirmed by manual removal of the placenta (the other was delivered normally).

From the literature and our own investigations we feel justified in stating that when a shadow of the above-mentioned shape and size is visible, either in the ventral or dorsal upper uterine segment. pl. p. may be ruled out. If, on the other hand, the placental shadow is in the lower ventral or dorsal uterine segment or if not visualized at all, there is reason to suspect pl. p. or perhaps low implantation and to carry out further diagnostic procedures (cystography). Since soft-tissue radiography appears to afford an easy and reliable method of determining the placental site — a method which requires no special preparation and involves no discomfort to the patient — we feel justified in publishing this small series, particularly as the application of this technique has not previously been reported from Denmark.

SUMMARY

After reviewing the methods of diagnosing placenta prævia the author describes the soft-tissue radiography and reports a material of 52 patients. The placental shadow was directly visualized in 50 cases. Since the method is easy, reliable, and involves no discomfort to the patient, it is recommended as a primary diagnostic procedure in suspected cases of placenta prævia.

ZUSAMMENFASSUNG

Nach einem Überblick über die Methoden zur Diagnose der Plazenta prävia beschreibt der Verf. die Weichteilradiographie und berichtet über ein Material von 52 Patienten. Der Plazentaschatten war in 50 Fällen direkt sichtbar. Da die Methode einfach, zuverlässig und für die Patienten nicht unangenehm ist, wird sie als primäre diagnostische Untersuchung in Fällen mit Verdacht auf Plazenta prävia empfohlen.

RÉSUMÉ

Après un rappel des méthodes permettant de diagnostiquer le placenta prævia, l'auteur décrit la radiographie des parties molles et présente un matériel de 52 observations. L'ombre placentaire était directement visible dans 50 cas. Comme le procédé est simple et fidèle, sans présenter aucun désagrément pour la patiente, il est recommandé comme première étape dans le diagnostic des cas susceptibles de présenter un placenta prævia.

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PNEUMORETROPERITONEUM

Technique and Results

by

Stig Fagerberg

A new procedure for rendering the kidneys and adjacent organs roentgenoparent was described by ROSENSTEIN in 1921. It was based on the principle of injecting gas into the perirenal fat directly from the dorsum. The contrast produced by the gas made the kidneys visible, and »on some» — so he wrote — »successful films the suprarenal glands look like caps on top of the kidneys». This was the first attempt at direct roentgenologic visualization of the retroperitoneal space. At first the method aroused considerable enthusiasm. But technical obstacles and severe complications, even deaths, brought it into disrepute, although the passage of years saw numerous modifications introduced (ROSENO, NOSZKAY, CAHILL, MENCHER, COPE & SCHATZKI, and others). The abundance of vessels in the region with resultant dangers of embolism and hemorrhage, the risks of pleural lesions and spread from inflammatory foci were some of the many deterrents.

The advent of an improved technique has now made it possible to inject gas retroperitoneally in a much simpler and, apparently, harmless manner, viz. by presacral gas insufflation, as described in 1948 by the Spaniard RIVAS. His method gave the impetus to an increased use of gas as a contrast agent in unpreformed spaces.

Dorsomedially the retroperitoneal space is bounded by the spine and by the diaphragm, dorsolaterally by the psoas and the quadratus lumborum muscles, cranially by the musculature of the diaphragm, ventrally by the parietal peritoneum, and caudally by the loose connective tissue of the pelvis. The retroperitoneal organs — kidneys, suprarenal glands, pancreas, duodenum, the ascending and descending

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colon and the large vessels — are all wholly or partly embedded in more or less loose, fatty or connective tissues.

It should be kept in mind, further, that on either side the kidney and the suprarenal gland are enclosed in a fatty casing, the adipose capsule. The latter is invested by a connective tissue envelope, the renal fascia, consisting of a ventral and a dorsal membrane which are fused laterally, medially and cranially. The renal fascia thus forms a sac with a caudal opening by which the renosuprarenal capsule communicates freely with the rest of the retroperitoneal space (fig. 1).

The two suprarenal glands differ slightly in shape and position. The right is triangular and lies immediately above the kidney, to the cranial pole of which it is loosely connected. The left tends to be semilunate and lies somewhat medially of the cranial pole to which it is more intimately connected.

Owing to the anatomic continuity that exists between the connective tissues of the pelvis and the retroperitoneal space, a pelvis emphysema induced in the presacral region can spread out retroperitoneally without being hampered by any barriers (fig. 2). When a medium, less roentgenopaque than the tissues, such as oxygen, is introduced, a plain roentgen image is produced of the kidneys and the suprarenal glands. (Occasionally the left suprarenal gland may be hard to visualize, probably because of the anatomic relationship mentioned above making it more difficult for the gas to penetrate between kidney and suprarenal gland on the left side.) The psoas muscle contrasts beautifully against the surrounding gas, and parts of the liver and diaphragmal musculature can be seen. At times the vena cava can be observed crossing the right psoas muscle and passing beside the right kidney and suprarenal gland. On the other hand, for unknown reasons the pancreas does not as a rule become visible.

The following are *indications* for the use of the examination.

A. In renal diagnostics in order to estimate the position, shape and size of the kidney when other current methods fail, as may be the case in poorly developed adipose capsules, in intractably constipated or gas-laden bowels, as well as in hypoplastic and ectopic kidneys.

B. In tumours and hyperplasias of the suprarenal glands, *e. g.* in Cushing's syndrome, certain forms of pseudohermaphroditism and pubertas praecox, and other endocrine disorders, hypertension in pheochromocytomas etc.

C. In retroperitoneal neoplasms of other kinds: fibromas, sarcomas, para-aortic glandular metastases, Sternberg's disease, leukemia, etc.

Apart from anal and perianal infections necessitating some change in the site of injection, there are no *contraindications*. The procedure

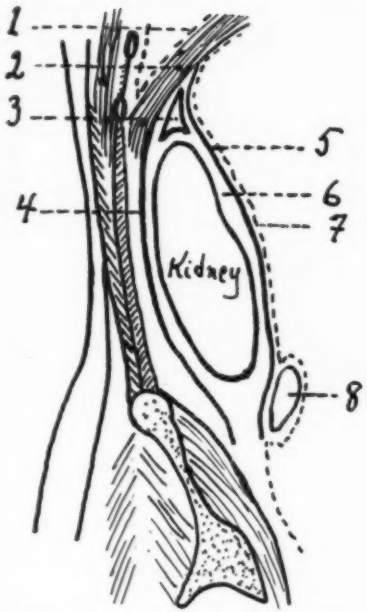

Fig. 1. Parasagittal section through kidney and suprarenal gland. *1* pleura, *2* diaphragm, *3* suprarenal gland, *4* dorsal membrane of renal fascia, *5* ventral membrane of same, *6* adipose capsule, *7* parietal peritoneum, *8* colon.

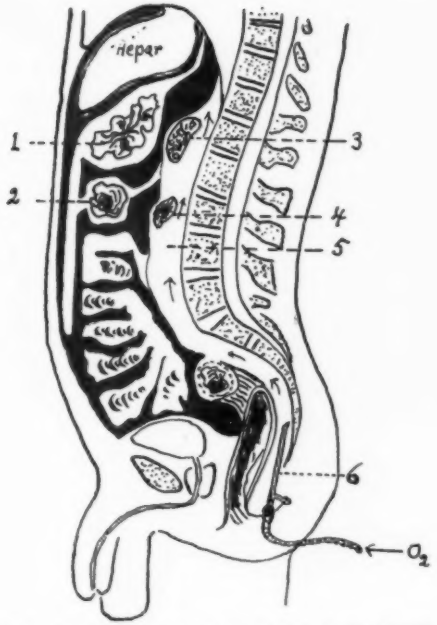

Fig. 2. Median section through abdomen and pelvis. *1* ventricle, *2* transverse colon, *3* pancreas, *4* duodenum, *5* retroperitoneal space, *6* injection needle presacrally.

is applicable to patients of all ages, including infants (the youngest subject in the series discussed here was 4 months old).

The method has been employed at the Roentgen Clinic, Uppsala, for a little less than one year.

Technique. The patient is prepared by being given a mild sedative (a mild one because the examination is facilitated by the patient's co-operation) and an enema as before ordinary urography. He is placed on the examination table as is illustrated in fig. 3.[1] After suitable preparation of the anal region, a common lumbar needle is inserted in the medial line halfway between the anus and the tip of the coccyx. The

[1] As from the beginning of 1952 the technique has been modified a little. Now the insufflation takes place with the patient lying in side position — first on one side and then on the other, without moving the needle. This procedure is less uncomfortable for the patient.

Fig. 3. Patient's position on table.

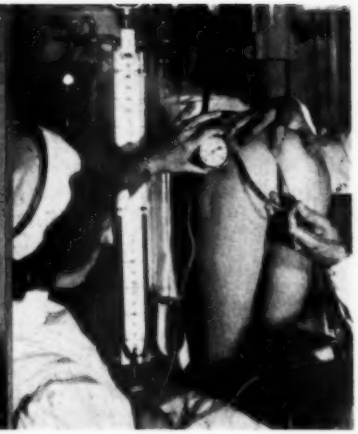

Fig. 4. Needle, pneumothorax apparatus and manometer interconnected by rubber tubing.

needle is then advanced in the sagittal plane towards the inside of the sacrum behind the rectum after perforating the anococcygic ligament and the levator ani muscle, for a distance of 4—6 cm into the loose presacral tissues. Aspiration is attempted to ensure that the tip of the needle does not lie intravasally; the needle is now connected to an ordinary Forlanini's pneumothorax apparatus filled with oxygen, cf. fig. 4.

Oxygen is superior to air because it is absorbed rapidly — after 24 hours hardly any will be left — and because it does not give rise to emboli if a little should seep into the bloodstream.

900—1,200 ml of oxygen (depending on the tolerance of the patient) are injected. If the needle be correctly inserted the gas will enter quite easily. The amount required will also vary with the build of the patient: lean persons with taut connective tissue will require a higher pressure than fat people with loose connective tissue. Consequently it is impossible to cite a standardized manometer reading; in our cases it ranged between 30 and 60 cm of water.

That the gas is going in as it should, may be ascertained, partly by the patient's own reports of a dull pain in one or both groins followed by a sense of tension in the loin and partly by a typical tympanitic percussion tone over the latter area. Should the sensations show a definite tendency to be localized laterally the needle should be redirected towards the »quiet» side — making sure, of course, that the needle remains extravasally. The injection should be made slowly and ought to take 15—20 minutes.

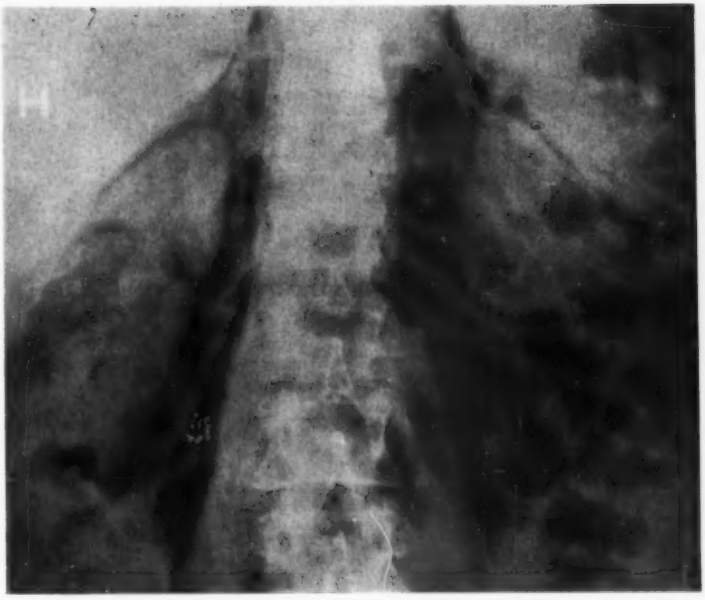

Fig. 5. Normal case after gas insufflation.

The discomfort experienced by the patient is not particularly marked, unless the injection be forced. It usually subsides in about half an hour with only a stiff feeling remaining in the loin for the next 24 hours. After the injection the patient may be allowed to walk unaided to his bed where he should lie down on his back with the foot-end of the bed lowered, in order to make it easier for the gas to permeate upwards towards the diaphragm. Should the gas have accumulated on one side only and it is desired to have it on both, the patient should be placed with the gas-laden side downwards. By so doing the gas may be directed to the other side.

On the subject of technique it should also be mentioned that in children the insufflation is carried out under anesthesia; basis anesthesia is administered in the ward and, if necessary, reinforced with ether while the gas injection is given. The amount of gas injected should, of course, be smaller, *e. g.* 100 ml in a child aged 3—4 months.

In our cases, almost exclusively affections of the kidneys and suprarenal glands, the roentgenograms are made in the frontal supine, oblique and, sometimes, side projections with the patient recumbent. The examination is combined with tomography, the youngest children ex-

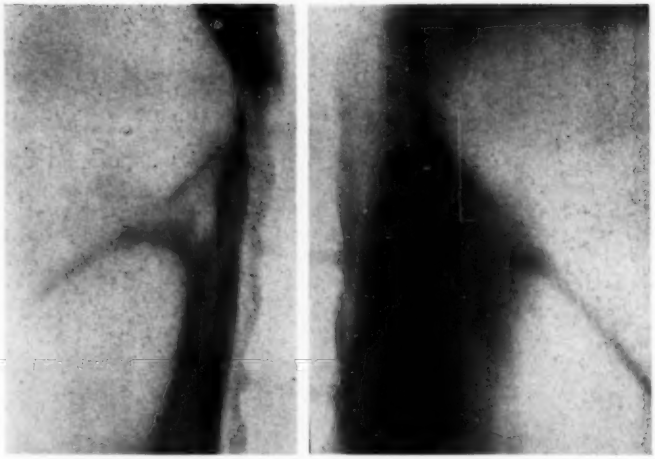

Fig. 6. Tomogram of the same case as in fig. 5. Suprarenal glands plainly visible.

cepted; disturbing intestinal contents in front of the retroperitoneal space will consequently be eliminated.

No *complications* were encountered. With a faulty technique however, the following might occur:

A. Perianal emphysema — if the needle is not passed deeply enough through the anococcygic ligament.

B. Rectal perforation — if the needle is pushed too deeply and contact with the sacrum lost.

C. Intravasation of the needle.

A. and B. are harmless complications, but the investigation had better be postponed for a day or two. C. can be prevented by carefully observing the necessity for, and the result of, aspiration. The region selected for the injection is poorly supplied with vessels, and the use of oxygen almost wholly eliminates the risk of embolism.

My own observations are based on a series of 18 patients of whom 13 were adults aged between 19 and 75 years and 5 were children from 4 months to 15 years of age. In 15 of these cases we studied the suprarenal glands in the following conditions: hypertension, Cushing's syndrome, diabetes, pseudohermaphroditism, gigantism and Addison's disease. The object in one of the remaining cases was to visualize the kidneys (case 3), in another to look for a pancreatic tumour or a retroperitoneal

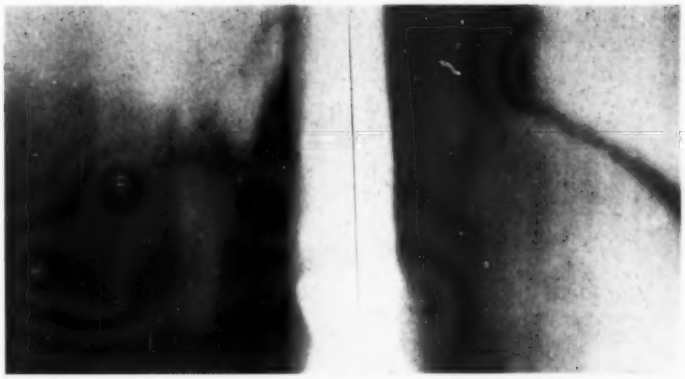

Fig. 7. Tomogram of a normal case. Note medial position of left suprarenal gland.

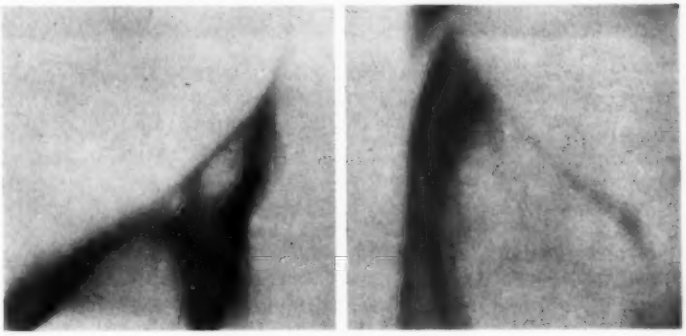

Fig. 8. Tomogram of normal case. Left suprarenal gland invisible.

neoplasm of some other kind, and in the third — a child aged 4 months — to ascertain experimentally whether the method would also be satisfactory in infants. Infants have relatively larger suprarenal glands than adults, the ratio weight for weight between the suprarenal gland and the kidney being 1: 10 at the age of six months (1: 20 in adults).

The suprarenal glands in 10 of the 15 patients with suspected suprarenal affections became visible, as a rule — plainly. Of the remaining 5 subjects 2 had had operations on one side — exploration and extirpation respectively — and, as could be expected, only the contralateral gland was seen. In 2 patients only the right suprarenal gland could be distinguished, and in the last case neither gland was clearly

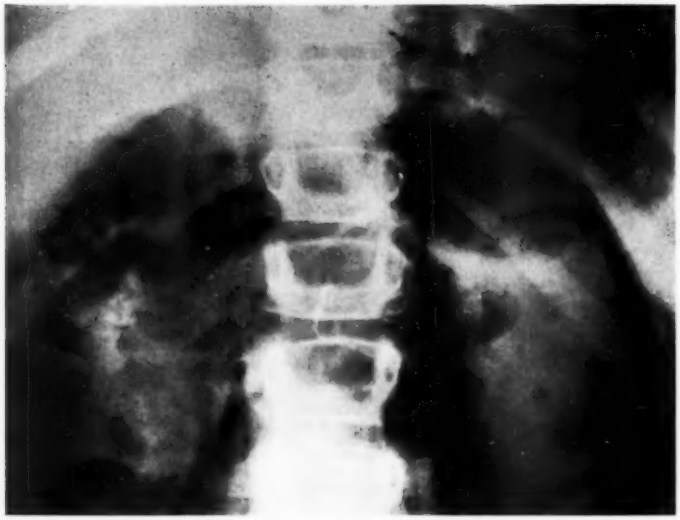

Fig. 9. Case 1. Left suprarenal gland massively filling suprarenal space and surrounded by abnormally small amounts of gas. On right side no gas has reached the suprarenal capsule because of post-operative adhesions.

visible — necropsy some months later disclosed very advanced bilateral atrophy of the suprarenal glands (case 2).

Fully normal conditions were observed in 15 of the 18 cases (figs. 5, 6, 7 and 8), while more or less abnormal appearances were noted in the other 3 cases. Accordingly, I shall deal only with the latter.

Case 1 (*A. S. U—a, 270/1951*): A girl aged 3½ years who had undergone treatment at the Departments of Surgery and Pediatrics at the University Hospital from March to December, 1950, and also in March, 1951, under the diagnosis of »pseudohermaphroditism (adrenogenital syndrome)». She presented a typical picture of adrenogenital syndrome with clitorism, sinus urogenitalis, hypertrophic labia majora, hypotrophic and malformed labia minora, feminine internal genitals, and excessive excretion of urinary 17-ketosteroids. She showed a tendency to be sexually precocious and was mentally retarded; she had manifest, apparently diffuse, hyperplasia of the right suprarenal gland, which was verified at laparotomy in June, 1950. Following extirpation of the right suprarenal gland — which was rather overgrown and weighed 14 g — an adrenocortical insufficiency state set in postoperatively. The latter disorder was cured by large doses of eschatin. Mental development then progressed markedly and the genital status remained at least stationary. The urinary 17-ketosteroids declined from a maximum of 21.7 mg per 24 hours to a minimum of 3.8 mg per 24 hours, but thereafter rose once again to the supernormal level of 6.9 mg per 24 hours.

Fig. 10. Case 2. Irregular striae at site of suprarenal glands.

Pneumoretroperitoneum (12. 3. 51.): insufflation of 650 ml of oxygen. The left suprarenal gland massively filled the suprarenal space. It was surrounded by abnormally small amounts of gas. As there were no signs of a tumour it was either a hyperplasia or a compensatory hypertrophy of the gland. No gas reached the suprarenal capsule on the right side, probably because postoperative adhesions had formed (fig. 9).

Case 2 (A. S. U—a, 296/1951): A boy aged 7½ years who had been treated for Addison's disease on repeated occasions in 1950 and 1951 at the Pediatric Clinic, University Hospital. He was admitted because of tiredness, leanness, poor appetite and vomiting. He was small, delicate and under weight and had a propensity to hypotension. He tired easily, had low sodium and chloride levels and a potassium level on the high side. Some of the tests for suprarenal function were abnormal (Kepler's test, ACTH test, insulin tolerance test), but glucose tolerance and excretion of urinary 17-ketosteroids were normal. Adrenocortical insufficiency having been diagnosed, Doca was given and Percorten tablets implanted, whereupon the condition markedly improved.

Pneumoretroperitoneum (19. 3. 1951): insufflation of 600 ml of oxygen. The suprarenal glands could not be distinguished with certainty on either the right or on the left side. A few irregular, striated densities only, were noted in the suprarenal regions (fig. 10).

The patient was readmitted two months later. This time he was unconscious and showed signs of an Addisonian crisis, probably aroused by an infection of the upper respiratory passages. In spite of being given large doses of eschatin intravenously, the patient died. *Necropsy* disclosed bilateral atrophy of the suprarenal glands, highly marked in the cortices. There were also bronchopneumonia.

Case 3 (A. S. U—a, 3751/1950): A man aged 22 years who had been treated at the Medical Clinic in September and October 1950 for hematuria. Urography showed evidence of cystic kidneys although many attempts failed to reveal the renal contours.

Pneumoretroperitoneum (20. 10. 1950): insufflation of 900 ml of oxygen. Both kidneys, and particularly the left, were much enlarged (fig. 11).

Fig. 11. Case 3. Enlarged left kidney.

One may feel justified in stating that the method presented appears to be a good successor to the technically complicated and often dangerous procedure of perirenal gas insufflation that formerly was occasionally employed. It is, in addition, the best means we have as yet of diagnosing suprarenal affections roentgenologically. The procedure is, moreover, a good complement both to the ordinary types of renal investigations and to more indirect studies of the retroperitoneal space.

SUMMARY

After a short review of the anatomy of the retroperitoneal space, the author describes his experience with the roentgen examination of this space by means of presacral insufflation of oxygen. It is possible to perform the examination even in children. The youngest patient was four months old.

ZUSAMMENFASSUNG

Nach einer kurzen Übersicht über die Anatomie des retroperitonealen Raumes beschreibt der Verf. seine Erfahrung über die Röntgenuntersuchung dieses Raumes mit Hilfe von praesakraler Insufflation von Sauerstoff. Es ist möglich, die Untersuchung auch bei Kindern durchzuführen. Der jüngste Patient war 4 Monate alt.

RÉSUMÉ

Après un bref rappel de l'anatomie de l'espace rétropéritonéal, l'auteur décrit ses expériences sur l'examen radiologique de cette région à l'aide d'une insufflation présacrée d'oxygène. On peut pratiquer cet examen même chez des enfants. Le plus jeune sujet examiné avait 4 mois.

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DEPTH-DOSE DATA FOR ROENTGEN RADIATION AT 30—100 KILOVOLTS

by

H. C. Burger, R. Braams[1] and *J. F. C. Werz*

Introduction

Dosimetry of roentgen radiation at 30—100 kv has often been discussed in the literature. Most authors however consider only some of the parameters which affect the depth-dose relationship. As yet a complete theoretical treatment of this problem has not been produced. The processes contributing to the total ionisation caused by a given beam of roentgen rays are very complicated and this is, in the authors' opinion, a reason why theoretical calculations, as a basis for depth-dose curves for clinical use, are unsuitable.

For certain simple cases DE WAARD (1948) has solved the problem of the dose distribution as a function of depth. Although his calculations are still rather complicated, his results are most instructive. For a monochromatic, cylindrical beam of roentgen rays in water, DE WAARD finds (in certain circumstances) maximum ionisation at a depth of some mm; the depth depends amongst other things on the wavelength of the radiation. This result could be of importance in dermatological roentgen therapy and for this reason the dermatologists at Utrecht University attached great importance to an experimental proof of DE WAARD's theoretical results.

In this paper the authors wish to present information about the way in which depth-dose relationships are affected by the several parameters which influence them.

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Survey of the Effective Variables

Let us first consider the parameters involved to decide which of them needs further consideration:

a) Anode current in mA (I).

If the other parameters are kept constant the dose is proportional to the anode current in the roentgen ray tube. Simple experiments have verified this fact and it needs no further investigation.

b) Anode-cathode voltage difference in kilovolts (smoothed or unsmoothed) (V).

A change in the anode voltage is followed by a change in the spectral distribution of the emitted roentgen quanta. Because of the wave length dependence on the absorption- and scattering coefficients of roentgen rays, this results in a change in the depth-dose curves.

c) Thickness of aluminium filter in mm (Al).

The spectral distribution of the radiation emitted by the anode is changed after filtering by the glass wall of the roentgen ray tube and any aluminium filters which may be added. After the absorption of the softer radiation in this way the depth-dose curves will have a lower slope.

d) Distance of anode to irradiated surface (F_s).

Apart from the lowering of the dose by absorption there is a decrease of the dose with increasing distance from the radiation source. The inverse square law gives the intensity at a point as a function of the distance to the radiation source. This law has often been treated in the literature and is proved by the results of many experiments. It will not therefore be considered further here.

e) Area of beam in cm^2 at the irradiated surface (O_d).

The dose at a certain point has contributions of radiation scattered from other points. There is a considerable amount of scattering at angles of up to 90 degrees and this makes the dose near the surface dependent on the area of the diaphragm.

f) Total thickness of phantom (d).

The dose at a certain point can receive contributions from even deeper points by radiation scattered at angles greater than 90 degrees (back scattering) and therefore the thickness of the irradiated layer has an influence on the depth-dose curves.

g) Effective atomic number (Z).

The atomic composition of the irradiated material, characterised by the effective atomic number, Z, affects the absorption and scattering

coefficients of the radiation and therefore $\bar{Z}$ has a great influence on the dose.

The dose D at a depth x can therefore be written as a function of the parameters above, as follows:

$$D = D\ (I,\ V,\ Al,\ F_s,\ O_d,\ d,\ \bar{Z},\ x)$$

The influence of I and F_s is well-known: the present series of experiments is concerned with the effect of the parameters V, Al, O_d, d, $\bar{Z}$, x:

$$D = D\ (V,\ Al,\ O_d,\ d,\ \bar{Z},\ x)$$

A constant potential roentgen ray tube was used since the results from tubes with an alternating voltage across them can be deduced from the constant voltage data.

The choice of the phantom material was governed by a few calculations. With the aid of the method treated by MAYNEORD (1937) and SPIERS (1946) effective atomic numbers were calculated for several compounds. These are given by the expression:

$$\bar{Z}^{2.94} = a_1 Z_1^{2.94} + a_2 Z_2^{2.94} \qquad a_n Z_n^{2.94}$$

where a_i is the fraction of the electrons contributed by the element with atomic number Z_i. Table 1 gives some of these effective atomic numbers:

air	7.70
water	7.42
skin	6.89
blood	7.47
muscle	7.33
fat	5.71
perspex	6.47
isoprene	5.55

Perspex (density 1.19 gr/cm³) is seen to have an effective atomic number between that of fat and muscle. The effective atomic number of »mean tissue» depends very much on the thickness of the subcutaneous fat layer which, according to MAXIMOW and BLOOM (1948), varies between 1—30 mm.

For this reason the variation in the effective atomic number of mean tissue will be very great, and measurements carried out in perspex will have sufficient accuracy for therapeutic application in dermatology. In fact, when there is a certain amount of subcutaneous fat, the values will be better than those obtained in a water phantom, as can easily

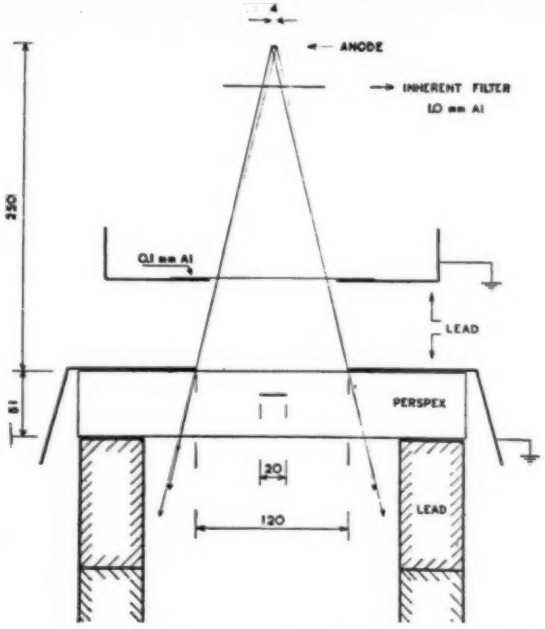


Fig. 1. Geometry of the experimental arrangement showing the perspex sheets which form the ionisation chamber. All measurements are in millimeters.

be seen from table 1. The correction for the difference in density from that of mean tissue, is less than 2 % for the first 10 mm from the surface when $F_s = 25$ cm or more; this correction has therefore been neglected.

Experimental Method

The ionisation chamber was made by sticking together three one mm thick sheets of perspex each 30 × 30 cm.

The middle sheet had a hole of 2.0 cm diameter in the center and the volume so formed was filled with air at normal pressure. Circular electrodes of thin graphite (1—2 μ thick) were rubbed in to the outer sheets of the perspex. The leads from the electrodes to the outside of the perspex sheets were strips of »aquadag» (colloidal carbon). The potential between the electrodes was 8 volts, supplied by a battery; this was found to be sufficient to saturate the ionisation current in the chamber. The air gap of 1.0 mm may seem long compared with the mean range of 50 kv electrons (3.1 mm in air at normal pressure), but a calibration was carried out against a standard ionisation chamber (KÜSTNER) in the

Fig. 2.

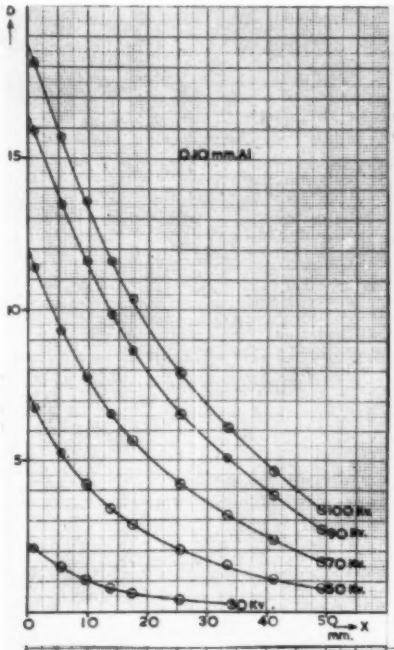
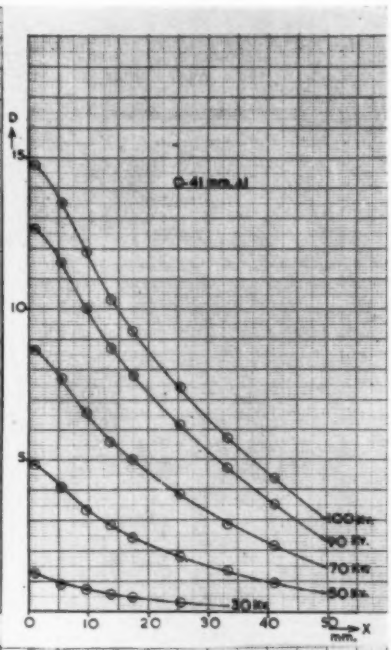


Fig. 3.



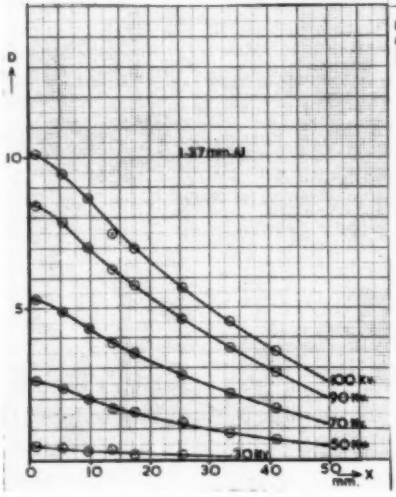


Fig. 5.

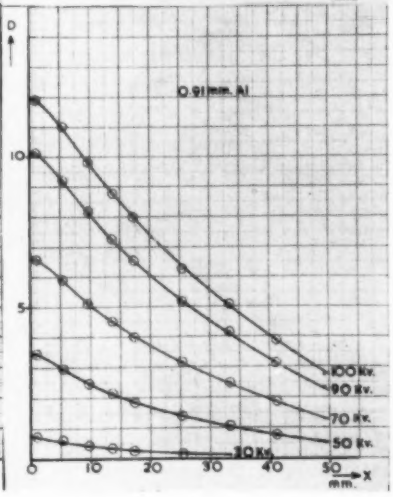


Fig. 4.

Fig. 2—5. Depth-dose curves in arbitrary units. For all curves: circular diaphragm of 12 cm diameter. Inherent filter 1.0 mm Al. $F_a = 25.0$ cm.

Fig. 6. Fig. 7.

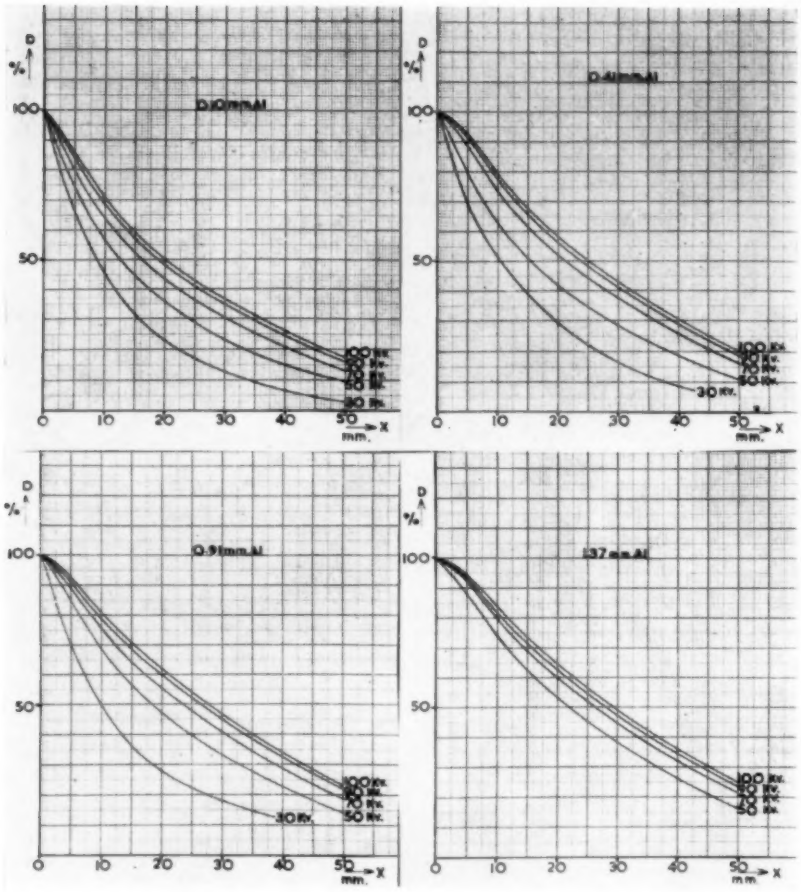


Fig. 8. Fig. 9.

Fig. 6—9. The same curves as in fig. 2—5 but normalised to a value of 100 % at the surface.

Philips Physical Laboratories and showed no wave length dependence between 30—100 kv to the accuracy of the calibration measurements (2—3 %).

The ionisation chamber here described was placed between two piles of perspex sheets; the thickness d and the depth x could then be varied in a very simple manner.

Fig. 10.

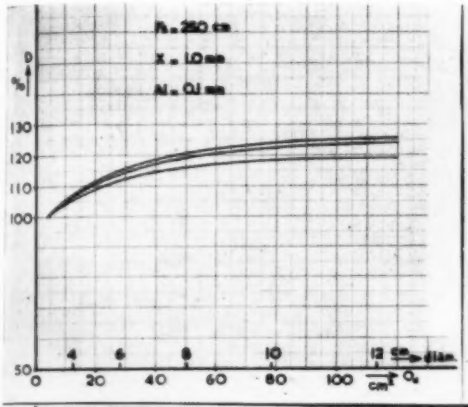


Fig. 11.

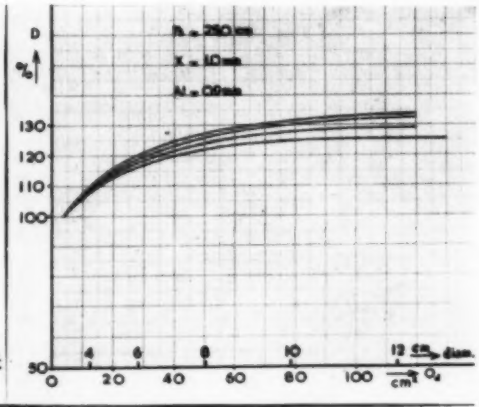


Fig. 12.

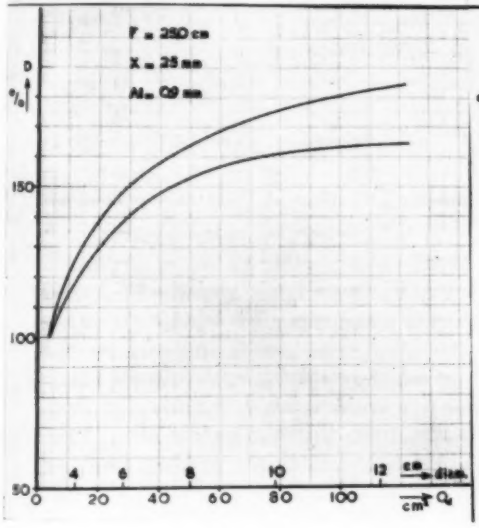


Fig. 13.

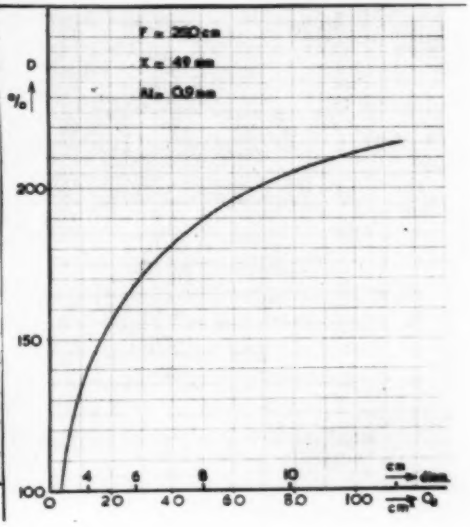


Fig. 10—13. The dose at a given depth as a function of the diaphragm area. All diaphragms circular. The 100 % dose represents the dose as measured with the smallest diaphragm (2.1 cm diameter). The curves shown in fig. 10 are for 90, 70 and 50 kv; in fig. 11 for 100, 90, 70 and 50 kv; in fig. 12 for 100 and 50 kv; and in fig. 13 for 100 kv, respectively.

The ionisation current was measured with a single valve d. c. amplifier. By using wire-wound resisters, by under-running the filament of the valve and by the use of batteries it was possible to diminish zero-drift

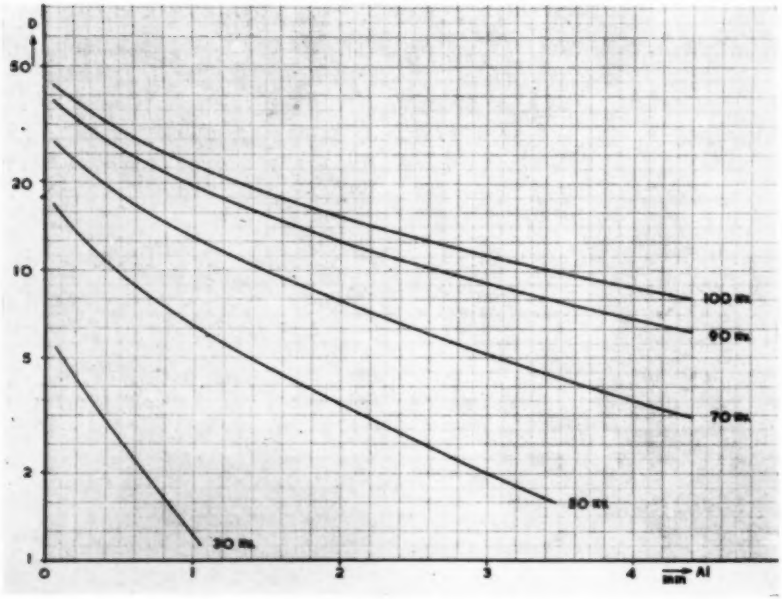


Fig. 14. Transmission curves for aluminium. The inherent filter of the tube was 1.0 mm Al.

to such a degree that with the aid of a Victoreen grid resistor of 3×10^9 Ω, measurements could be made with an accuracy of 5×10^{-14} amp.

The roentgen tube current was kept at a constant value of 1.00 mA and the voltage ripple in the d. c. voltage-supply thereby kept below 1 %. Fluctuations in the anode current were caused mainly by fluctuations in the heater current of the roentgen tube but were often relatively much greater (10—20 times). To prevent these fluctuations, an attempt was made to stabilise the heater current but finally it was found simplier to adjust the filament current by hand regulation and read the ionisation current only when the tube current was exactly 1.00 mA. The mean value of between 3 and 5 such observations was taken as a probable value; the final result was the mean of three probable values. In this way measurements with an accuracy of $^1/_2$ % in the tube current value were obtained.

The voltage across the roentgen tube was measured with a resistance of about 10^9 Ω formed by 100 grid resistors of 10^7 Ω. The grid resistors were coated with a layer of synthetic resin so that dust and moisture had no effect on their normal resistance values. The energy

dissipated in each resistor was small and caused only a negligible change in the resistance value due to temperature change or too high a current. By means of a variable transformer the anode voltage was kept at the desired value with an accuracy of ½ %.

The relative humidity in the room where the experiments took place, was not more than 40 % and the temperature was kept at 20° ± 2° C.

Corrections were made for temperature and barometric pressure as follows:

$$U_c = U_m \cdot \frac{1015}{p} \cdot \frac{T}{293}$$

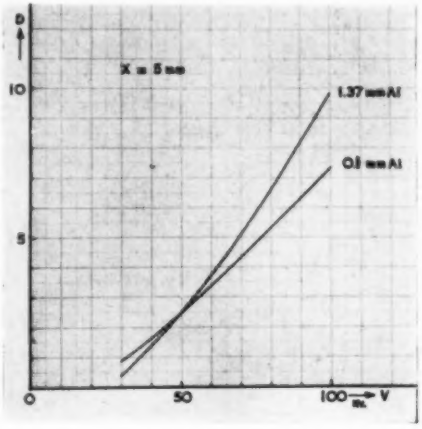


Fig. 15. The dose at 5 mm depth as a function of the voltage; tube-current kept at 1.00 mA. Both curves in arbitrary units and normalised to the same value at 50 kv.

where U_c is the corrected ionisation current, U_m the measured ionisation current, p is the barometer pressure in mbar and T the temperature in degrees absolute.

The current amplification of the amplifier was calibrated before and after every series of measurements with a constant current of 10^{-12} amp. following a method described by OOSTERKAMP (1948). To prevent disturbances by electric fields, the measuring apparatus (including the pile of perspex sheets) was placed in a screened lead box with a thin aluminium window through which the roentgen rays entered.

Results of Measurements

Ionisation measurements were made at depths of 1—50 mm with four different filters and five different voltages. The results are plotted in fig. 2—9. The curves are certainly not exponential but on the other hand they give no evidence of a maximum as the calculations of DE WAARD predicted. The accuracy of the measurements was estimated as 1—2 % and this may not be enough to show with certainty a weak maximum.

The dose was measured as a function of the field size (O_d) at different depths in the phantom, the voltage and filter being kept constant. The results (figs. 10—13) show the same tendencies as those of MAYNEORD and LAMERTON (1941).

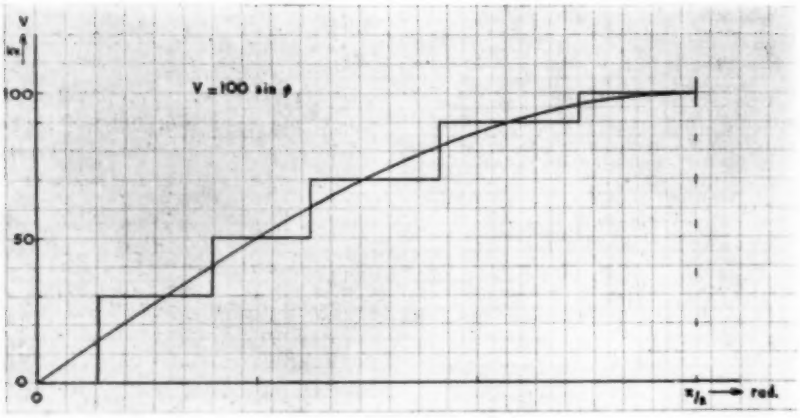


Fig. 16. Sine wave function approximated by a staircase function.

With the ionisation chamber alone in air the ionisation current was measured for different filters and voltages (field-size constant). These results are plotted in fig. 14. Measurements were also made in a pile of perspex, 10 cm thick; these gave curves with slightly higher values than those with a thickness of 5 cm, the other parameters being kept constant. For soft radiation (low voltages or thin filter) no difference between piles of different thickness was measurable, but for more penetrating roentgen rays, the dose in the deeper layers was significantly changed by the pile thickness.

The effect of a high sulphur content of the skin was investigated by using pure rubber sheets (isoprene, $\bar{Z} = 5.55$) in which sulphur had been incorporated (97 % isoprene + 3 % S gives $\bar{Z} = 6.44$). With soft radiation it was possible to prove a difference in dosage under the rubber layer when a pure rubber sheet was replaced by one with 3 % S content. A sheet of 3 mm thickness with 3 % S at 30 kv and with a 0.1 mm Al filter produced higher absorption than pure rubber (6 ± 2 %); assuming absorption only (no back-scatter) and monochromatic roentgen rays of $\lambda = 0.60$ Å calculation predicts a difference of 4.5 ± 0.5 %.

The back-scatter from bone was measured by replacing the sheets of material under the ionisation chamber by bone. At 100 kv, 1.4 mm Al, and 1 mm perspex between the air volume of the chamber and the bone layer, the ionisation current increased by 4 ± 2 %. On increasing the thickness of the perspex layer between the chamber and the bone to 2 mm, the effect disappeared (error in measurement ~ 2 %).

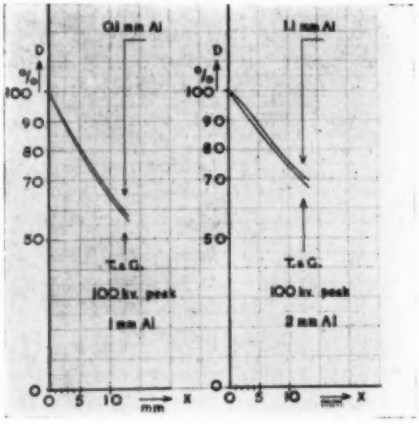


Fig. 17. Results of numerical integration of our data, at parameter values as used by TROUT and GAGER (1949), and compared with their results. The upper curves are ours (diaphragm: 12 cm diameter; 0.1 and 1.1 mm Al); the lower, the curves of TROUT et al. for $V_{peak} = 100$ kv, 1 and 2 mm Al, $F_s = 25.0$ cm. It is assumed that their filter value of 1 mm Al is equivalent to our 0.1 mm Al, the variation being caused by a different inherent filter.

Conclusions

1) The curves of figs. 6—9 show that it is possible to irradiate the first few mm from the surface with a nearly uniform dose.

2) A maximum, if present, is too small to be of medical importance.

3) By changing the filter thickness and the voltage, the thickness of the layer receiving a nearly uniform dose (e. g. a dose of over 90 %) can be changed.

4) The influence of sulphur in the skin (the normal content is 0.7 %) does not affect the dose sufficiently to be taken into consideration, even when, in pathological conditions, the sulphur content is very high.

5) The back-scatter from bone does not produce an important contribution to the ionisation in the tissue layers lying between the bone and the irradiated skin.

6) The curves of fig. 15 show that a 1 % change in the voltage causes a 2—3 % change in the dose. The voltage must be kept constant to within 1—2 % if the dose is to be delivered with an accuracy of 5 %. The other parameters (filter and diaphragm) do not have such a marked effect on the dose-rate curves.

7) With the aid of data for constant voltages, figures for a known form of alternating current can be calculated by numerical integration. Information is needed about the current saturation of the roentgen tube used. Assuming a constant tube current, although the anode voltage is changing (this is an approximation), it is only necessary to divide the sinusoidal voltage-time curve in a staircase function as shown in fig. 16.

Calculating the results to be expected with parameter values used by TROUT and GAGER (1949), the curves found are in close agreement with those given by them; as is shown in fig. 17. TROUT and GAGER made measurements in beef; the correction from perspex to beef is certainly very small in the first cm from the surface. The difference can be explained by small differences in the parameter values and by the different types of ionisation chambers used.

SUMMARY

With a view to clinical application, the authors have investigated the influence of different parameters (voltage, filter, diaphragm) on depth-dose curves for roentgen rays between 30 and 100 kv from a tube with an inherent filter of 1.0 mm Al. Curves are given for depths up to 5 cm in a perspex phantom. The influence of sulphur in the skin and the back-scatter from bone were measured and found not to be of great importance.

ZUSAMMENFASSUNG

Mit Hinblick auf die klinische Anwendbarkeit haben die Verf. den Einfluss verschiedener Parameter (Volt, Filter, Raster) auf die Tiefendosiskurven von Röntgenstrahlen zwischen 30 und 100 KV einer Röhre mit 1.0 mm Aluminium Eigenfiltrierung untersucht.

Kurven für Tiefen bis 5 cm in einem Perspexphantom werden mitgeteilt. Der Einfluss des Schwefels in der Haut und die vom Knochen ausgehende Streustrahlung wurden gemessen und man fand, dass sie nicht von grosser Bedeutung sind.

RÉSUMÉ

Les auteurs ont étudié, en vue de l'application clinique, l'influence de différents paramètres (voltage, filtre, diaphragme), sur les courbes de doses en profondeur pour des rayons roentgen émis sous 30 à 100 kv par un tube à filtre fixe de 1.0 mm Al. Ils donnent les courbes isodoses jusqu'à une profondeur de 5 cm dans un fantôme en perspex. L'influence du soufre de la peau et les radiations diffusées par le squelette ont été mésurées et reconnues peu importantes.

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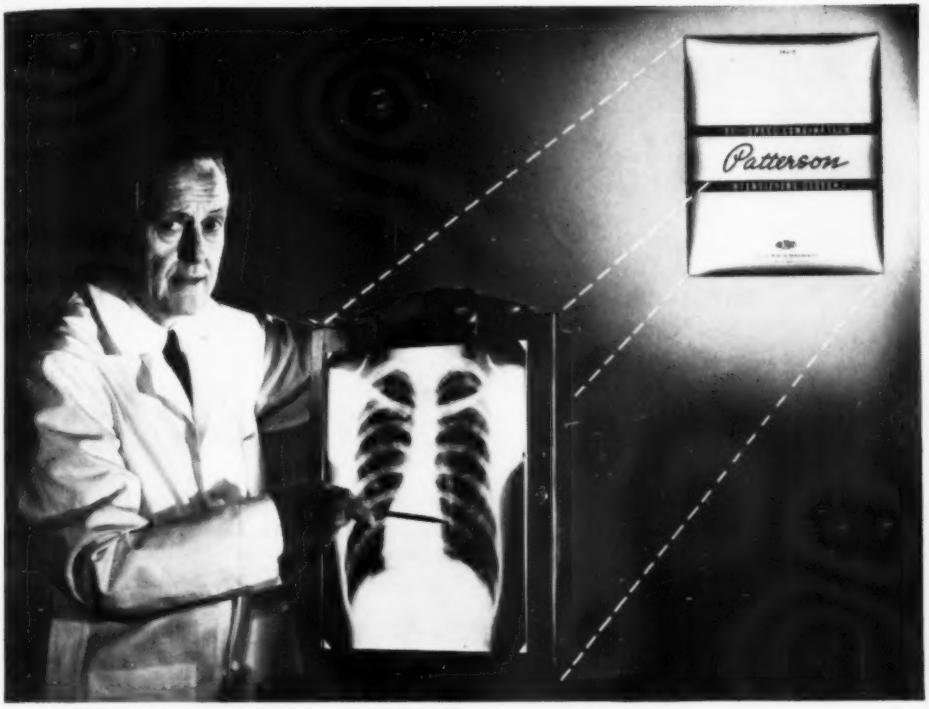

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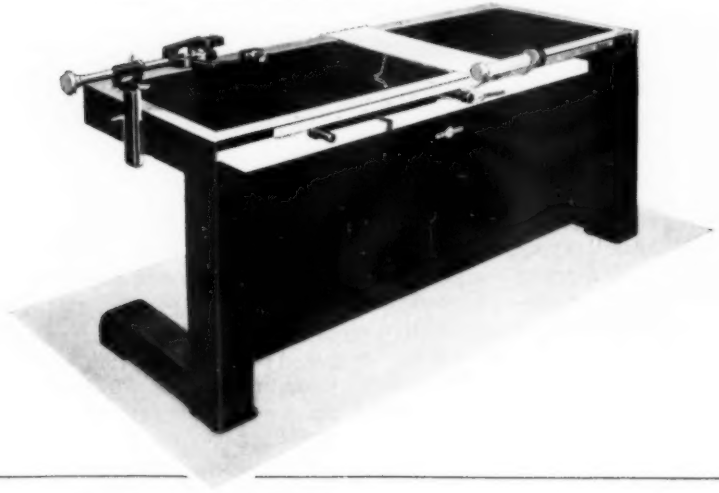

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AUS DER RÖNTGENABTEILUNG (LEITER: PRIV.DOZ. DR. R. HAUBRICH) DER MEDIZINISCHEN UNIVERSITÄTS-KLINIK (DIREKTOR: PROF. DR. P. MARTINI), BONN, DEUTSCHLAND.

RÖNTGENKYMOGRAPHISCHE STUDIE AN OPERIERTEN PANZERHERZEN

von

R. Haubrich

Obwohl bereits von FETZER, HECKMANN, STEHR, STUMPF u. a. die Veränderungen im Kymogramm des Panzerherzens ausführlich diskutiert worden sind, ist eine Übereinstimmung über die Spezifität der einzelnen pathologischen Bewegungstypen noch nicht erreicht. Auf die Ursachen, die einer einwandfreien Deutung der Bewegungskurven entgegenwirken, sind HAUBRICH u. THURN unlängst näher eingegangen; der wichtigste Grund liegt in dem Umstand, dass die Verschwielung und Verkalkung des Pericards sehr variabel auftritt, sodass alle Fälle von Panzerherz morphologisch untereinander differieren. Schon deshalb ist es von Interesse, die kymographische Symptomatologie durch einen Vergleich der Bewegungsabläufe vor und nach Operation zu erweitern. Ausserdem kann die Röntgenanalyse im Rahmen einer ausgedehnteren Funktionsprüfung (STOLLREITER) besondere Bedeutung gewinnen, seit mit der modernen Operationstechnik die Erfolgschancen für die frühzeitige Operation stark gestiegen sind (BRUNNER, DECKER, ZENKER). Die folgende Studie an Hand von Bewegungsbildern vor und nach Operation des Panzerherzens erhebt keinen Anspruch darauf, die hier interessierenden Probleme vollzählig zu behandeln oder endgültig zu klären. Sie beruht auf einem röntgenkymographisch eingehend untersuchten Krankengut von 6 operierten Panzerherzen, an dem der Reihe nach einige pathologische Bewegungssymptome diskutiert werden sollen.

Pathologisch kleine Randzacken im Kymogramm einer konstriktiven oder verkalkten Pericarditis gelten als Ausdruck eines verringerten Schlagvolumens; sie sind nach erfolgreicher Pericardektomie meist vergrössert (STUMPF, ANACKER). Es ist aber wichtig daran zu denken, dass dies scheinbar so eindeutige Symptom auch irreführen kann. Wenn durch

Bei der Red. am 15. Nov. 1951 eingegangen.

die Operation eine weitgehende Mobilisation des vorher schwielig mit der Umgebung fixierten Herzens erfolgt, können andere Teile der Herzoberfläche im Röntgenbild randständig werden. Durch die pulsatorische Rotation um die Herzlängsachse kommen z. B. solche nicht umschwielten Teile des linken Ventrikels an den caudalen linken Herzrand, die vor der Operation dorsal und medial des linken Herzkonturs gelegen und ohne Einfluss auf die sichtbare Randbewegung waren. Ähnliche Verhältnisse können auch dann vorliegen, wenn postoperativ eine marginale kalkfreie Zone erscheint oder breiter wird, die vorher schmäler war oder gar nicht in Erscheinung trat; daran ist auch zu denken, wenn die Herzgrösse vor und nach Operation gleich ist. Kann sich postoperativ das Herz im ganzen wieder ausdehnen, dann ist eine Vergrösserung der Randzacken jedoch immer auch ein Zeichen der gebesserten Funktion bzw. eines grösseren Schlagvolumens. Ganz eindeutig zeigt Abb. 1 diesen Operationserfolg. Die Bewegungsausschläge am linken Herzrand waren vor dem Eingriff mittelgross, die am rechten Herzrand aufgehoben; nach der Operation finden sich rechts deutliche Randbewegungen, links eine viel grössere Amplitude. Da der Transversaldurchmesser des Herzens nach der Pericardektomie erheblich zugenommen hat, kann die Vergrösserung des Bewegungsraumes besonders hoch bewertet werden. Der electrocardiographische Befund zeigt dementsprechend auch eine Aufhebung der vorher gemessenen Niedervoltage. Dass die Erhöhung des Spannungspotentials von 0.4 auf 1.1 mV tatsächlich auf den Herzmuskel selbst zurückzuführen ist, wird nur durch die beidseitige Vergrösserung der kymographisch registrierten Randbewegung bewiesen. Fehlt in anderen Fällen dieser kymographische Parallelbefund, dann kann der grössere Ausschlag auch auf verbesserter elektrischer Ableitung z. B. infolge Fortfalls der portalen Stauung bzw. vorher bestehender Pleuratranssudate beruhen.

Ausser spangen- und reifenförmigen Kalkeinlagerungen kommen mitunter auch schalenartige Umpanzerungen ganzer Herzhöhlen vor. Im Gegensatz zur Ansicht von Hohenner finden sich schalen- oder becherförmige Verkalkungen auch an der Herzspitze, wie Stehr mitgeteilt hat und wie sie auch einer unserer Fälle aufweist. Die pericardiale Kalkeinmauerung des linken Ventrikels erscheint auf dem normalen Röntgenbild (Abb. 2 a) komplett. Erst das Bewegungsbild lässt erkennen, dass am oberen linken Herzrand noch kleine Bewegungen stattfinden (Abb. 2 b). Das ergänzende Kymogramm mit senkrechtem Schlitz zeigt ausserdem noch Randzacken an der Herzbasis (Abb. 2 c). Danach handelt es sich um eine grosse Kalkschale, die durch mindestens zwei Lücken oder Scharniere unterbrochen ist und somit noch eine bestimmte Eigenpulsation gestattet; die Operation bestätigte diese Annahme. Wir haben in einer früheren Publikation aus diesem Befund das Postulat abgeleitet, mit der Verwendung mehrerer, atypischer Schlitzeinstellungen kymographisch nach sol-

Abb. 1 a. Abb. 1 b.

Abb. 1 a u. b. Panzerherz vor und nach Operation. Deutliche Vergrösserung der Bewegungsamplitude an beiden Herzrändern trotz grösseren Transversaldurchmessers.

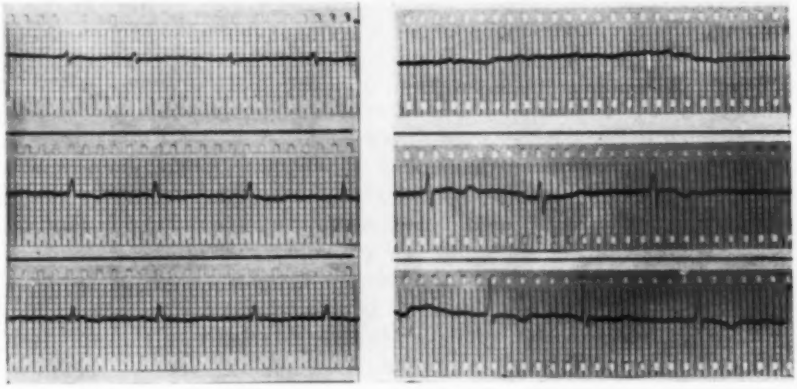

Abb. 1 c. EKG des gleichen Falls: durch Operation Erhöhung des Spannungspotentials von 0.4 auf 1.1 mV.

chen Panzerlücken zu suchen, bevor von einer völligen Bewegungsstarre einer ganzen Herzhöhle gesprochen und daraus ein Beweis für die ausschliessliche Förderleistung des Atrioventrikulartrichters gezogen werden darf (Haubrich u. Thurn). Abb. 2 gibt echte Eigenpulsationen wieder, weil das Panzerherz hier passiv ganz unbeweglich war, d. h. keine Lagepulsation aufwies. Inselartig kalkfrei gebliebene Randanteile zeigen oft eine überraschend grosse Amplitude ihrer Eigenbewegung, wie seit Heckmann und Stehr bekannt ist; offenbar treten sie kompensatorisch für andere,

Abb. 2 a. Abb. 2 b. Abb. 2 c.

Abb. 2 a. Scheinbar komplette Kalkschale um die Herzspitze (re. vord. Schrägstellung).
Abb. 2 b u. c. Im Kymogramm noch Randbewegung an den Panzerlücken (Pfeil). Hemmung von Systole und Diastole.

ganz stillgelegte Randgebiete ein. Ihre Zackenform ist im Kymogramm der Abb. 2 besonders interessant, weil sie nicht nur eine Hemmung der Diastole, sondern auch der Systole andeutet. Dass die Diastole behindert war, zeigte bei der Operation die schlagartige Ausweitung dieses Herzabschnitts nach Resektion der Schwiele. Die Abschrägung und Verkürzung des systolischen Zackenschenkels bedeutet nach FETZER und HECKMANN eine Behinderung der Systole; auch dies Röntgensymptom wurde operativ bestätigt. Wir haben schon früher betont, dass solche Fälle als Beweis dafür gelten müssen, dass die Herzfunktion bei sehr starker Konstriktion im ganzen eingeschränkt ist. Ob sich im Einzelfall die Störung kymographisch mehr als Behinderung der einen oder anderen Herzphase ausdrückt, hängt von sehr verschiedenen Faktoren ab: Dicke, Verkalkungsgrad und Schrumpfungstendenz der Schwiele, Kombination mit einer äusseren

Abb. 3. Gleiche Deformation der Randbewegung nur durch umschriebene Myocardschwiele.

Schwiele (Accretio) und vor allem vom Zustand der Herzmuskulatur. Wir stimmen mit HECKMANN völlig darin überein, dass die röntgenkymographischen Symptome der Systole- wie auch der Diastolehemmung allein durch einen Muskelschaden hervorgerufen sein können. Dafür wird mit Abb. 3 ein direkter Beweis erbracht; durch eine umschriebene derbe Myocardschwiele resultiert hier in der Mitte des linken Ventrikelrandes eine ganz ähnliche Deformierung der Bewegungszacken.

Ring- oder reifenförmige Kalkumschnürungen einer Herzhöhle werden nicht selten beobachtet; sie entstehen dort, wo infolge geringerer Herzbewegung sich das Exsudat am längsten halten kann oder in Furchen der Herzoberfläche am dichtesten liegt. Ein Beispiel hierfür ist Abb. 4, wo ein Kalkring um den ganzen rechten Ventrikel bestand, der mit seiner linken Hälfte im Sulcus interventric. lag. Dieser Ring muss die Pulsation der rechten Herzkammer vor allem diastolisch stark einschränken. So wird am atypischen Kymogramm mit senkrechtem Schlitz (Abb. 4 b) erkennbar, dass eine wesentliche Seitenverschiebung durch die pulsatorische Verlagerung des Massenmittelpunktes nicht erfolgen konnte. Nach der partiellen Pericardektomie zeigt der Kalkring an seinem interventrikulären Teil (Abb. 4 c) gleichfalls eine nur geringe Seitenverschiebung, welche die Eigenpulsation in richtiger Amplitude wiedergibt. Die Analyse der Bewegungen der kalkimprägnierten Grenze zwischen den beiden Ventrikeln ist aber grundsätzlich verschieden, je nach dem, ob gleichzeitig eine Accretion des Pericards an die Nachbarorgane besteht oder nicht. Im Beispiel der Abb. 4 c ist durch die vorausgegangene Operation die Fixation an die mediastinale Pleura gelöst, sodass sich die rechte Kammer diastolisch beiderseits ausdehnen kann, also auch nach rechts ventral und basal, im Gegensatz zu den Verhältnissen bei der Accretion bzw. vor der Operation. Die Bewegungslinie im Sulcus verläuft ohne Accretion spiegelbildlich zur lateralen Randkurve des linken Ventrikels. Man ersieht hieraus auch, dass die pulsatorische Verschiebung der Kammergrenzlinie vom höheren Druck des linken Ventrikels bestimmt wird, dessen Randbewegung der Eigenpulsationskurve eines rhythmisch unter Druck gesetzten Hohlraumes gleicht. Die Differenz der Amplituden an den beiden Rändern des linken Ventrikels ergibt die wahre pulsatorische Bewegungsbreite; der Einfluss der Herzrotation auf die Lageänderung ist hierbei nicht berücksichtigt.

Die Verkalkung im Sulcus interventric. s. coronarius bedeutet den Gewinn einer weiteren sichtbaren Herzhöhlenbegrenzung. Dieser Vorteil lässt sich auch am Vergleich der Bewegungen dieser verkalkten Ventrikelgrenze vor und nach Operation demonstrieren. Im Fall der Abb. 5 bestand ausser einer plattenförmigen Kalknarbe an der Herzbasis auch eine Kalkschwiele im Sulcus coronarius. Diese bewegt sich vor der Operation verzahnt d. h. gleichsinnig synchron mit der lateralen Randkurve des linken

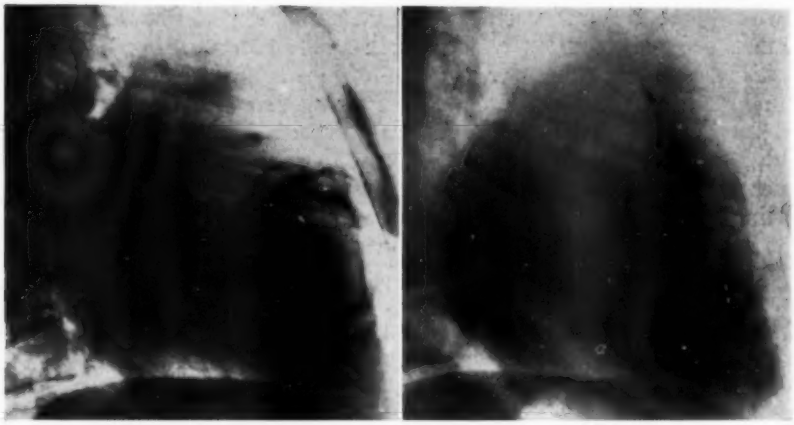

Abb. 4 a. Kalkring um den rechten Ventrikel vor u. nach partieller Pericardektomie.

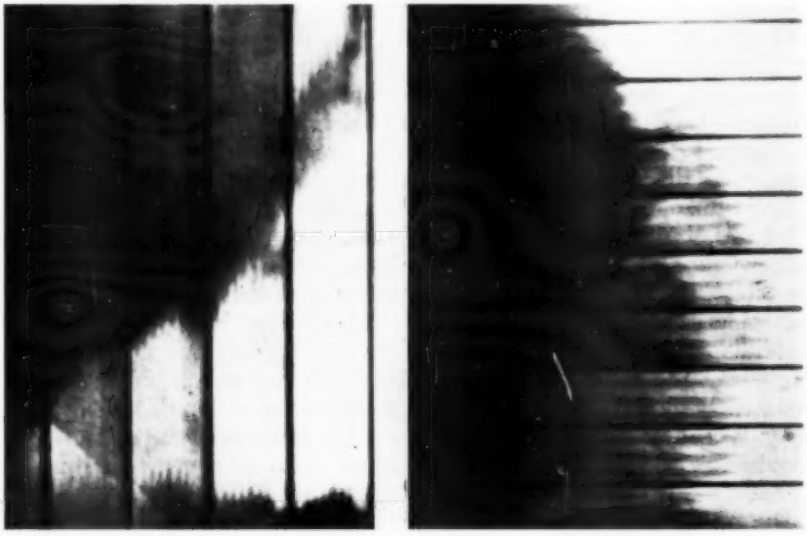

Abb. 4 b. Abb. 4 c.

Abb. 4 b u. c. Bewegung der verkalkten Ventrikelgrenzlinie (gleicher Fall).

Ventrikels und beweist eine gleichzeitige äussere Pericardschwiele (Accretio, Abb. 5), wie wir schon gezeigt haben; denn bei der Accretio kann sich der rechte Ventrikel diastolisch viel weniger nach ventral und basal

Abb. 5 a. Kalkspangen an der Herzbasis u. im Sulcus interventricularis (Tomogramm).

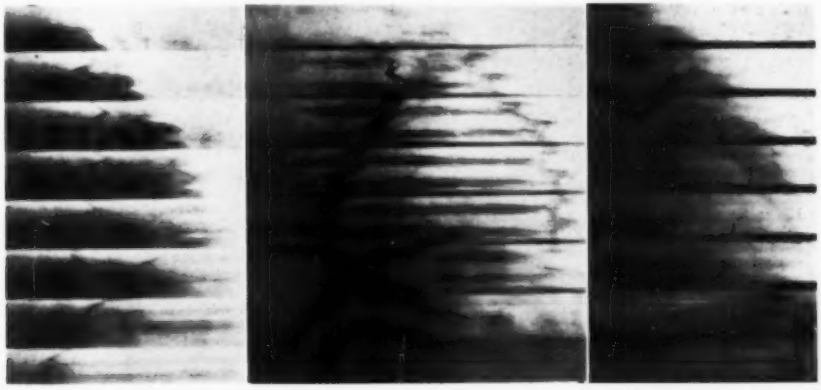

Abb. 5 b. Abb. 5 c. Abb. 5 d.

Abb. 5 b—d. Gleicher Fall. Umschlag der Bewegungsrichtung der verkalkten Ventrikelgrenzlinie nach operativer Lösung der Accretion.

ausdehnen. Er erweitert sich nach der Seite des kleineren Widerstandes, d. h. nach links, und verlagert den Rand der linken Kammer diastolisch durch Superposition noch weiter nach lateral. Mit der Operation, in der die Sulcusschwiele zwar nicht entfernt, die Accretion mit den Nachbarorganen aber beseitigt wurde, schlägt die Kurve der Ventrikelgrenze um

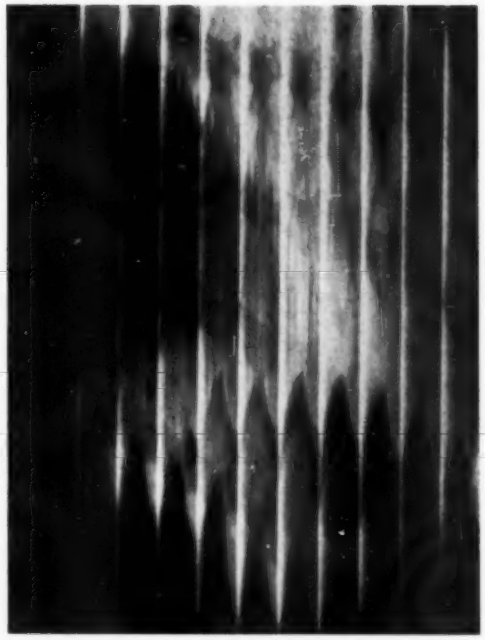

Abb. 6. Pathologische Bewegungszacken im Atmungskymogramm eines Panzerherzens mit diagnostischem Pneumoperitoneum.

(Abb. 5 c) und stellt jetzt mit ihrem spiegelbildlichen Verlauf zur Bewegungskurve des linken lateralen Herzkonturs den gleichen Typ wie Abb. 4 d dar. Bei der Kontrolluntersuchung nach einem Jahr (Abb. 5 d) ist dieser Bewegungstyp noch erhalten als Beweis dafür, dass eine neue postoperative Fixation der Herzoberfläche an die Nachbarorgane ausgeblieben und der klinisch gute Operationserfolg auch nach der kymographischen Analyse erhalten geblieben ist. Die Form der Bewegungszacken am lateralen linken Ventrikelrand wechselt von der Nasenform über ein diastolisches Plateau zu einer Spitzhakenform (Abb. 5 b—d). Dies bedeutet eine Verbesserung der muskulären Leistung.

Für die Diagnose einer Verwachsung beider Herzbeutelblätter (Concretio), wie sie beim Panzerherzen immer mehr oder weniger komplett vorliegt, ist ausser der Prüfung der passiven Lageverschieblichkeit des Herzens der Nachweis eines systolischen Zwerchfellzuckens besonders wertvoll (HAUBRICH). Im Atmungskymogramm pflegt in solchen Fällen eine pathologische Bewegung ganz zu fehlen. Die methodische Erweite-

Abb. 7 a.

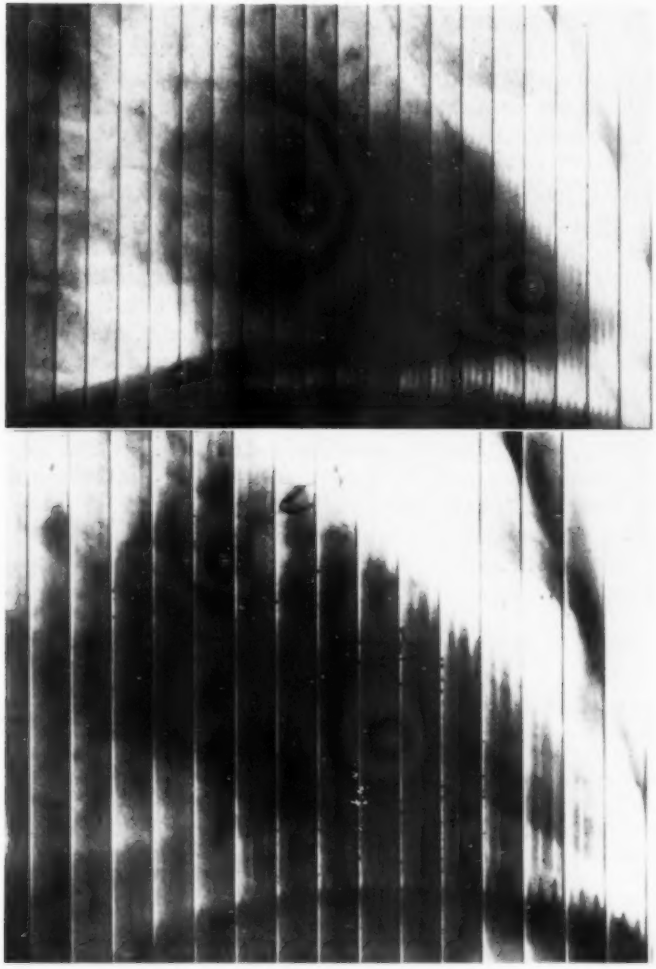

Abb. 7 b.

Abb. 7 a u. b. Panzerherz mit basaler Kalkschwiele vor und nach Operation. Postoperative Zunahme der Amplitude mit längerer diastolischer Endlage (re. vord. Schrägstellung).

rung durch ein diagnostisches Pneumoperitoneum zur Darstellung der basalen Pericardverkalkung und Venendrosselung kann schon mehr bedeuten, weil durch die Zwerchfellerhöhung eine Herzentlastung bzw. -verbreiterung bedingt sein kann, in der pathologischen Randzacken deutlicher werden mögen (Abb. 6). Noch wertvoller sind aber oft Kymo-

gramme in Schrägstellung und Atemstillstand. Vor der Operation zeigt sich dann, z. B. in Abb. 7 a, eine nur kleine Amplitude an der Herzbasis, deren vorwiegend dorsale Verkalkung gut sichtbar ist. Im ventralen Basisanteil ist die Bewegung grösser, sodass sich am Zwerchfell kleine systolische Zuckungen nach oben darstellen, die charakteristisch für eine Pericardobliteration sind. Durch die Operation ist die basale Kalkspange im Durchtrittsbereich der caudalen Hohlvene entfernt (Abb. 7 b); jetzt weist das Zwerchfell auch im dorsalen Anteil kräftige pulsatorische Zukkungen auf. Dieser Befund geht der klinischen Restitution mit Fortfall aller portalen Stauungssymptome parallel. Die Amplitude der Herzrandbewegung am rechten Ventrikel vorn oben hat deutlich zugenommen: ein weiterer Beweis für die verbesserte Herzleistung. Die Form der Ventrikelzacken ist am oberen Ventrikelkontur wie am basalen Rand, d. h. am diaphragmalen Herzbett, stärker abgestumpft; die Verwachsung ist hier nicht völlig gelöst. Ausserdem deutet die Ausbildung eines diastolischen Plateaus bei grösserer Amplitude darauf hin, dass das Herz sich jetzt weiter ausdehnen und für längere Zeit in der diastolischen Endlage verharren kann. Auch dieses postoperative Symptom bedeutet eine Verbesserung der muskulären Leistungsfähigkeit. Eine derartige Bestätigung des Operationserfolges im postoperativen Kymogramm haben wir mehrfach gesehen.

ZUSAMMENFASSUNG

Röntgenkymogramme vor und nach Operation zeigen die Art der Funktionsstörung des Panzerherzens und ihre partielle oder totale Korrektur durch die Pericardektomie. Vergrösserung und normale Umformung der Bewegungszacken sprechen für eine operative Besserung der Herzleistung, wenn das Herz im ganzen breiter geworden ist. Schwierigkeiten in der kymographischen Analyse entstehen durch die mögliche Randverschiebung der fraglichen Herzabschnitte infolge Lösung der Accretion. An Verlauf und Form der Ventrikelgrenzkurve (Verkalkung des Coronarsulcus) lässt sich die operative Schwielenlösung demonstrieren. Durch atypisch aufgenommene Kymogramme wird der Operationseffekt auf die Bewegung auch der Herzbasis sichtbar.

SUMMARY

Kymography before and after pericardiolysis is capable of demonstrating changes in function of the heart signifying partial or marked improvement in cases of calcifying pericarditis. If the heart has increased in width after operation and if the kymogram shows a return to normal or an exaggeration of the movement curves, improvement of the cardiac function may be assumed. Difficulties of analysis may be caused by a shift of the cardiac outline caused by division of existing adhesions. The shape of the ventricular outline and particularly the amount of calcification in the groove of the coronary artery permit assessment of the degree of success of the operation. Special kymographic technique enables a study of the motion at the base of the heart as well as the effect of the operative treatment to be made.

RÉSUMÉ

Les radiokymogrammes pré- et postopératoires montrent la qualité des troubles fonctionnels provoqués par la péricardite calcifiante, ainsi que leur disparition totale ou partielle à la suite de la péricardectomie. L'agrandissement et la normalisation des dents du tracé parlent en faveur d'une amélioration du mouvement cardiaque, quand le cœur a subi un élargissement réel. L'analyse kymographique est rendue plus délicate par le fait que la partie cardiaque examinée peut avoir été décalée par suite de la section des adhérences. Le cours et la forme du tracé correspondant à la limite ventriculaire (calcification du sillon coronaire) révèlent le décollage opératoire des couennes. Par un enregistrement atypique des kymogrammes il est possible de constater l'influence de l'opération sur les mouvements de la base du cœur.

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CONTRIBUTION AU RADIODIAGNOSTIC DE L'ULCÈRE DUODÉNAL

par

José Ferolla

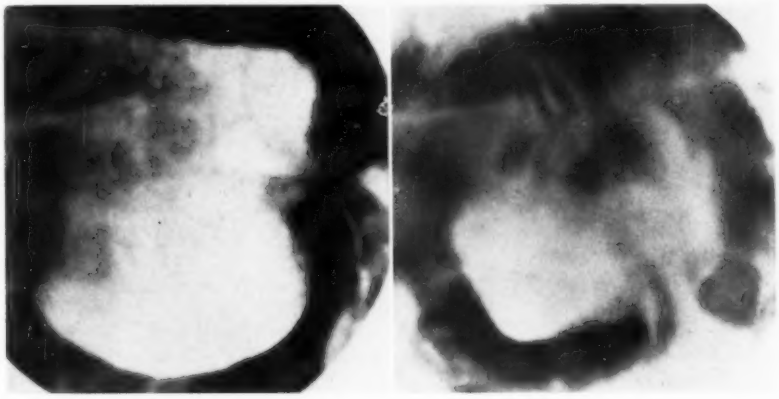
Au cours de l'examen gastro-duodénal, il est nécessaire que la portion examinée soit complètement vide, de sorte que la bouillie barytée puisse pénétrer dans tous ses plis; on obtient ainsi une image reproduisant avec exactitude la paroi interne de l'organe qui l'a modelée.

Cette condition est en général remplie lorsque le patient a observé un jeûne complet pendant les 12 heures environ qui précèdent l'examen. Cependant il y a des cas où nous n'arrivons pas à réussir une bonne imprégnation des plis de la muqueuse, malgré le vide apparent du duodénum, et où les images obtenues ne reproduisent pas avec exactitude l'aspect anatomique du relief interne du viscère. Ces images ne présentent pas non plus un aspect pathologique typique des lésions se localisant dans ce secteur du tube digestif.

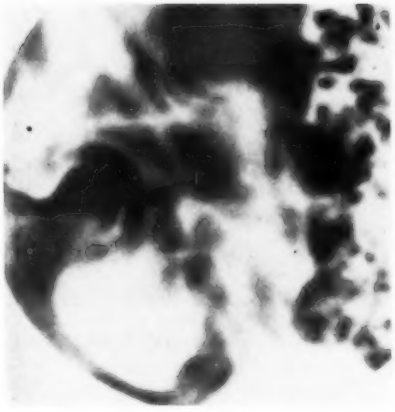
La cause peut en être une mucosité bouchant la cavité ulcérée, empêchant ainsi l'apparition de la niche. Ce phénomène ne doit pas être rare, car, outre les sécrétions propres de l'organe ulcéré, nous savons que dans 56 % des cas d'ulcère duodénal Albrecht, il y a conjointement une gastrite augmentant extraordinairement le contenu muqueux des cavités gastrique et duodénale.

La situation ressemble, du point de vue radiodiagnostic, à celle qui existe lors de l'examen des patients après hémorragie. Il est alors commun d'observer des aspects semblables à ceux décrits ci-dessus: absence de niche, relief peu marqué. Pour justifier la disparition de la niche, la majorité des auteurs admettent l'existence d'un caillot fermant la cavité de l'ulcère. (Dans les ulcères superficiels, la simple décongestion de la muqueuse par l'hémorragie fait disparaître la niche.) Dans deux cas où la niche avait disparu après une hématémèse, WINDHOLZ put vérifier dans chacun d'eux — par autopsie dans l'un et biopsie dans l'autre — que les cavités ulcérées étaient obstruées par un thrombus.

Soumis à la Réd. le 10 juillet 1951.



a. b.



c.

Fig. 1. a. Aspect grumeleux, absence totale du relief de la muqueuse.
b. Zone d'œdème dans la partie moyenne.
c. Niche »de face» dans la partie moyenne du bulbe.

Beaucoup d'autre radiologues ont certainement comme nous observé qu'au début de l'examen, dans les premiers remplissages du duodénum, dans la majorité des cas les images de relief ne se prêtent pas à une étude radiologique minutieuse. Quand l'estomac s'est en partie vidé, les images deviennent plus claires, les reliefs de la muqueuse apparaissent avec plus de détails. Dans certains cas, nous avons eu l'occasion d'observer l'apparition d'une niche après examen initial négatif. Sur la base de cette observation nous avons modifié la technique d'examen pour certains cas de la façon suivante:

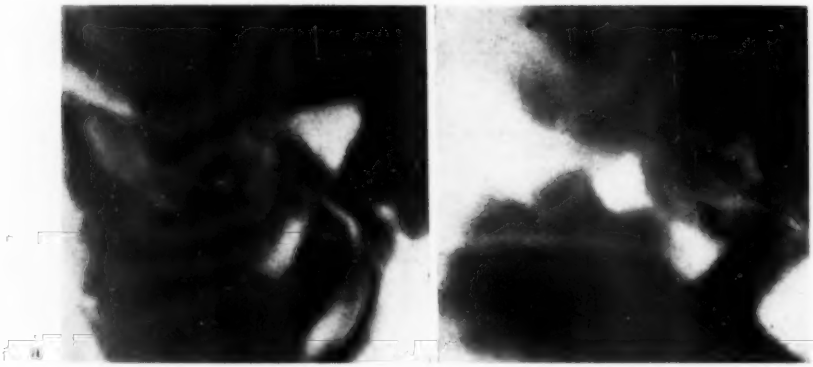


Fig. 2. a. Bulbe déformé. b. Niche typique.

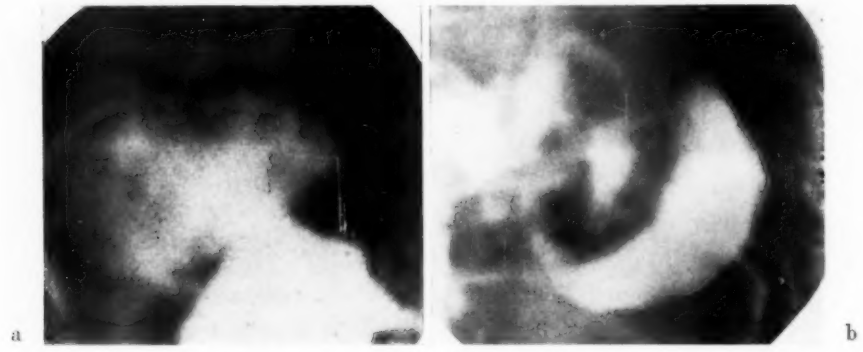
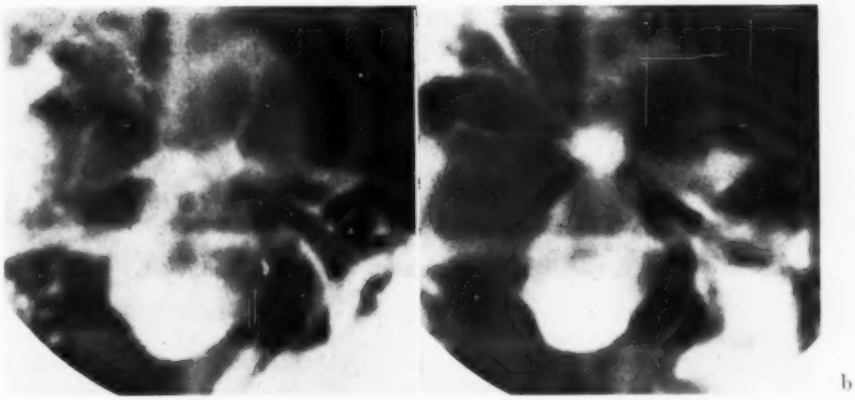


Fig. 3. a. Aspect granuleux sans niche apparente. b. Niche «de face» volumineuse avec bourrelet accentué d'œdème.

Après avoir fait l'examen du relief de la muqueuse gastrique distendre l'estomac avec la plus grande quantité possible de baryte et mettre le patient couché sur le côté droit, où il restera de cinq à vingt minutes selon le rythme de l'évacuation gastrique. Ensuite prendre des clichés du relief du duodénum suivant la technique de BERG. Nous utilisons donc le repas baryté lui-même comme agent mécanique capable de déplacer le mucus duodénal. Le résultat ressort des exemples-types indiqués.

Premier cas: Dans le premier examen (Fig. 1 a), fait avec les premiers remplissages, nous n'avons pas obtenu de reliefs: nous avons à peine obtenu une image semi-transparente, d'aspect grumeleux, avec absence totale du relief de la muqueuse. Nous avons placé le patient accoudé du côté droit, pendant dix minutes, et nous avons fait une seconde tentative. Dans cet examen (Fig. 1 b) on voit déjà une ébauche de relief à l'extrémité distale du bulbe et une zone d'œdème dans la partie moyenne. Dans l'examen suivant



a b

Fig. 4. a. Relief estompé sans niche apparente. b. Niche »de face» un peu plus petite qu'un grain de maïs, avec irradiation des plis de la muqueuse.

(Fig. 1 c), fait dix minutes après on observe nettement une petite niche »de face», localisée dans la partie moyenne du bulbe, avec irradiation des plis de la muqueuse.

Deuxième cas: Dans le premier examen (Fig. 2 a) le bulbe était déformé, présentant dans la partie médiane une image »en anneau». Dans l'examen suivant (Fig. 2 b), fait selon la technique indiquée, l'image transparente devient opaque, se transformant en une niche typique.

Sans doute, dans le premier examen, il y avait quelque chose dans la cavité ulcérée qui empêchait la pénétration de la bouillie barytée. Avec l'apparition de l'opacité de l'image dans le second examen, nous devons admettre que la baryte a remplacé ce qui bouchait temporairement le cratère de l'ulcère, après avoir déplacé cette substance par l'action mécanique pendant l'évacuation partielle de l'estomac. Cette substance pourrait être seulement du mucus épais qui s'était accumulé dans la cavité ulcérée.

Troisième et quatrième cas (Fig. 3 a—b et 4 a—b) conditions semblables.

Commentaire

Les cas confirment l'hypothèse formulée qu'un mucus épais peut fréquemment boucher temporairement la cavité ulcérée, empêchant ainsi l'apparition d'une niche, unique signe par lequel on peut affirmer avec certitude l'existence d'un processus ulcératif.

Il est à conseiller d'avoir cette possibilité toujours présente à l'esprit, surtout dans les cas où les symptômes cliniques suggèrent le diagnostic de l'ulcère et où les données radiologiques sont négatives. Nous avons assez fortement augmenté le nombre de nos examens positifs après usage systématique de la technique préconisée ci-dessus. Même dans les cas initialement positifs, nous ne prenons jamais d'images de relief du duodénum avec les premiers remplissages.

Après avoir éliminé les mucosités, le bulbe reste propre et les images obtenues sont anatomiquement plus exactes et plus riches en détails.

RÉSUMÉ

L'auteur attire l'attention sur le fait qu'un mucus épais est capable de boucher la cavité ulcérée, empêchant l'apparition de la niche, plus fréquemment qu'il ne l'est généralement admis. Il propose de déplacer le mucus par la baryte elle-même et conseille donc de prendre les images de relief du duodénum seulement après que l'estomac se soit un peu vidé, le patient étant couché sur le côté droit.

L'auteur présente quatre cas qui viennent appuyer l'hypothèse formulée.

SUMMARY

The author points out that thick mucus is capable of covering up an ulcer crater and masking a niche more frequently than is generally supposed. It is suggested that the mucus be displaced with the barium itself and recommended that films of the duodenal pattern should only be obtained after the stomach has been somewhat emptied, the patient having been turned on his right side.

Four illustrative cases are presented.

ZUSAMMENFASSUNG

Der Verf. macht darauf aufmerksam, dass ein Schleimklumpen dazu in der Lage ist, den Geschwürshohlraum zu verstopfen und damit das Auftreten der Nische zu verhindern. Dies ist viel häufiger der Fall als man es allgemein annimmt. Er schlägt vor, den Schleim durch Barium zu verdrängen; man sollte Reliefaufnahmen des Duodenum nur dann machen, wenn der Patient auf der rechten Seite gelegen hat und der Ventrikel sich ein wenig entleert hat.

Es werden 4 Fälle geschildert, welche diese Hypothese stützen.

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FROM THE ROENTGEN DEPARTMENT (DIRECTOR: PROFESSOR P. FLEMMING MØLLER)
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CLEIDOCRANIAL DYSOSTOSIS ASSOCIATED WITH OSTEOSCLEROSIS AND BONE FRAGILITY

by

Gregers Thomsen and *Mariano Guttadauro*

Cleidocranial dysostosis is a rare condition, of which, according to LASKER (1946), a total of 505 authentic and 30 questionable cases have been reported. From Denmark one case was described by KRABBE & FOGED in 1925, one by ELTORM in 1945, and three by KRABBE in 1950.

Although single case reports had been previously published, MARIE & SAINTON, in 1897, appear to have been the first to define the condition as a clinical entity and to coin its present name. They pointed out the heredity nature of the disease and the characteristic defects in the skull and clavicles, defects which are due to deficient and delayed ossification of the membranous bones. As demonstrated by subsequent authors however, there may also be deficient and delayed ossification of bones formed in cartilage, particularly those of the vertebral column, pelvis and coxae, and as shown by BRAILSFORD, of the distal phalanges of the fingers and toes. A common phenomenon is delayed and defective dentition, described as early as 1897 by MARIE & SAINTON, but in more detail by ANSPACH & HEUPEL.

In addition to the skeletal changes, the condition is often accompanied by muscular anomalies in the shoulder girdle. The patient described by KRABBE & FOGED had an abnormally high metabolic rate.

Owing to the characteristic skeletal defects, it is usually easy to diagnose the condition by roentgen examination. The roentgenologic changes in a typical case have been aptly described in this journal by ELTORM.

As in so many other congenital diseases, cleidocranial dysostosis may show changes differing from the typical ones. At the Roentgen Depart-

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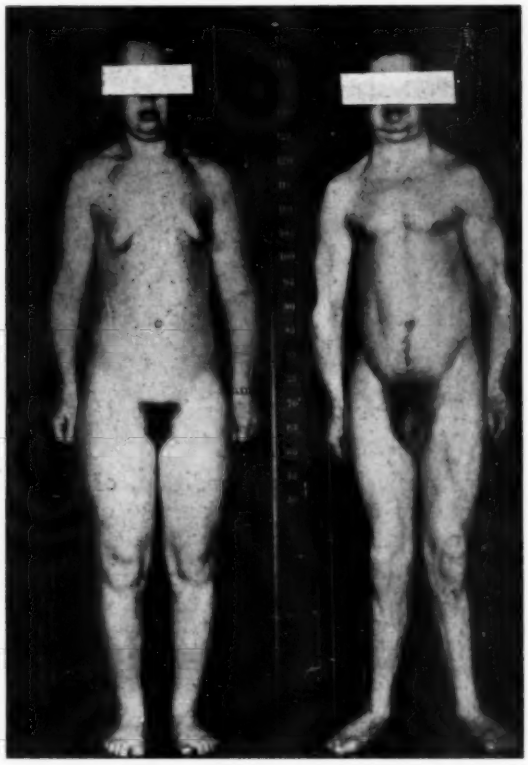

a. b.

Fig. 1 a & b. (a) Case I. (b) Case II.

ment of the University Hospital, Copenhagen, we have had occasion to observe two cases associated with generalized osteosclerosis and bone fragility.

Case 1. Female, born 7th June, 1931. (A brief report of this case was given by one of us (G. T.) to the Danish Radiological Society, Nov. 1948.) No family history of cleidocranial dysostosis; no signs of the lesion in her father, mother, or five siblings. Headache, fatigue, pain in the lower limbs for many years. Always of small stature, and at the age of 17 menstruation had not commenced. From 1938 she had sustained 7 fractures of the lower limbs, usually caused by minor injuries, such as missing a step, falling off a bicycle, etc. All the fractures healed within a normal period. As she was unable to do any hard work, she had applied for a sickness pension.

Physical examination: Height: 136 cm (which is the normal for a girl of 11). Weight: 39.5 kg.

Fig. 2. Case I. Contrast between the theca and the small facial bones.

The skull is square with open fontanelles, the anterior measuring 3 × 3 and the posterior 3 × 1 fingersbreadth. The forehead has marked transverse wrinkles, the cheeks are fat and the chin very small and receding. Eyes slightly protruding.

Marked caries and irregularity of the teeth: the palate shows a deep groove at the site of the raphe palati, but no fissure. Chest narrow and breasts small. Extremities stumpy with particularly short fingers. Mentally, the patient was retarded, her I. Q. being 85. Abdomen and vertebral column: normal. No ophthalmological or otological abnormalities.

Laboratory tests: Hb. 100 %. S. R. 5 mm/hour, W. R. negative, urine normal, B. M. R. plus 14 and plus 12 %, hormone analysis normal, serum calcium 10.2 mg%, serum phosphorus 2.6 mg%.

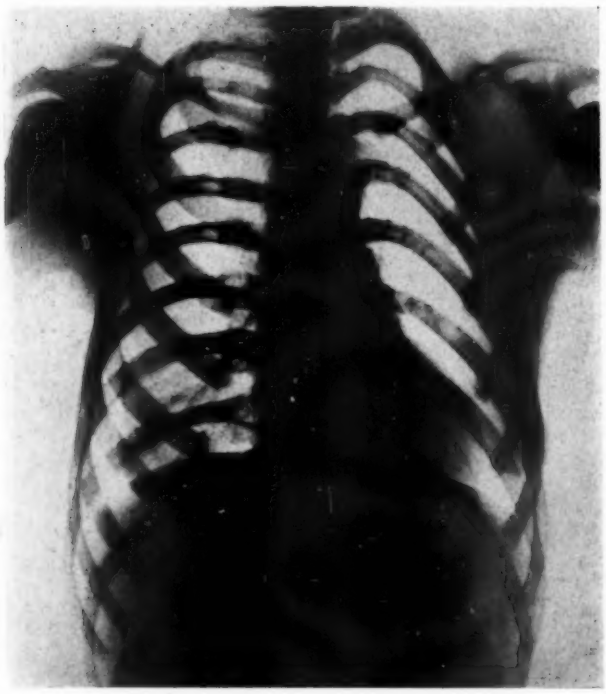

Fig. 3. Case I. Slight shortening of the acromial end of the clavicles; narrow chest.

Roentgen examination: The entire skeletal system exhibits generalized, very dense osteosclerosis which has partly narrowed and somewhat obliterated the medullary cavities in the long bones of the extremities. In the vertebral column the sclerosis is partly diffuse and partly present as a sort of frame around the spongy tissue of the vertebral bodies. In the skull and pelvic bones the density is pronounced, the normal structure being almost entirely obliterated.

The epiphyseal lines of the limbs are closed at most sites and open only at the distal ends of the femora and the proximal ends of the tibiae and fibulae. In the vertebral column all the superior and inferior epiphyseal rings of the vertebral bodies are preserved: in the pelvis, the epiphyses of the upper margins of the iliac crests and the margins of the tuber ischii are not yet fused, and in the scapula the epiphyseal line of the acromion is not yet closed.

The skull is of normal shape, but small for the age; very deficient ossification of the theca, open sutures and fontanelles noted. The sagittal suture is more than 1 cm wide; the anterior fontanelle measures $6 \times 3^1/_2$ cm and the posterior 4×3 cm. The deficient development is particularly striking in the occipital bone and the posterior part of the sphenoid bone; the lambdoid and occipito-mastoid sutures are wide open. Some Wormian bones are present.

Fig. 4.

Fig. 5.

Fig. 4. Case I. Very dense bone structure in the left upper limbs (as in all other limbs).

Fig. 5. Case I. Dense bone structure of the bones of the fingers. Tapering of the distal phalanges.

The base of the skull is rather flat. The inner ear exhibits dense sclerosis and poor development of the cells in the mastoid process. Sella turcica: normal.

The facial bones (Fig. 2) are small and poorly developed. No pneumatization of the frontal and sphenoid sinuses; ethmoid cells and maxillary antra: very small. Mandible: very small and angle flattened; dentition extremely irregular with numerous unerupted teeth in both the upper and lower jaws.

Chest (Fig. 3) narrow and long, clavicles slender, showing slight shortening of the acromial ends. Vertebral bodies short, but not deformed. Pelvis of normal shape with no changes in the symphysis pubis and hip-joints. The bones of the extremities (Fig. 4) are slender and short, those of the fingers and toes being particularly diminished, the distal phalanges tapering (Fig. 5) without ungual tuberosities. There are slight deformities of the femora and tibiae following previous fractures which have healed with considerable callus formation. (Fig. 6.)

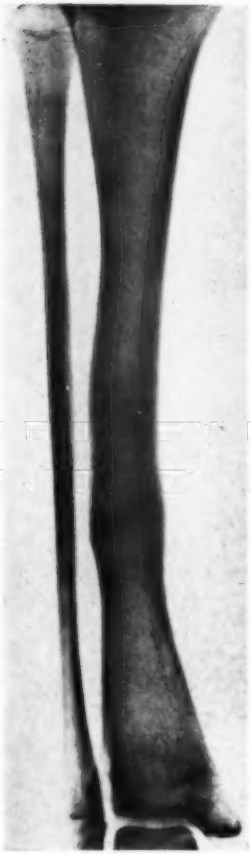

Fig. 6.

Fig. 7.

Fig. 6. Case I. Dense bone structure of the long bones of the right lower leg: old tibial fracture.

Fig. 7. Case II. Cranial defects and flattening of the angle of the jaw with fracture of right mandible; abnormal dentition.

According to information supplied by the patient's own physician after disharge from hospital, the patient sustained in the two following years spontaneous fractures of the left tibia and femur.

Case 2. Male, born 29th June, 1912. (The case was described by KRABBE in 1950, but is included in this report because of its similarity to Case 1.) Parents normal. One of 13 siblings, a sister exhibiting the same syndrome. Had sustained two fractures of the right lower limb, one of the femur after having been kicked by a horse, and another of the tibia after falling off a bicycle. In February 1949 the patient attended a dentist for pain in the right lower jaw; during an attempt at extracting 8 teeth the jaw was fractured.

Physical examination: Height: 146 cm. Skull: deformed and square; forehead: narrow; anterior fontanelle: open. Teeth defective and eruption irregular; a groove of the palate noted at the site of the raphe palati without an actual fissure. Chest: very narrow. Limbs: stumpy, the fingers and toes being especially short. Vertebral column normal. Skin and hair normal. Slightly retarded mentally. Laboratory tests: Hb. 100 %, urine normal, W. R. negative, B. M. R. plus 3 and plus 9 %.

Roentgen examination showed diffuse osteosclerosis of the entire skeletal system, but hardly as marked as in Case 1. The medullary cavities of the long bones of the extremities are narrowed; in the vertebral column the sclerosis is mainly diffuse, similar changes in the skull being chiefly localized to the base. All epiphyseal lines closed.

Skull of normal shape (Fig. 7), but small for the age. Extremely deficient ossification of the theca; all sutures and fontanelles open. The ossification of the occipital bones and of the squamous portions of the temporal bones is particularly deficient. The anterior fontanelle measures 7 × 7 cm and the posterior, 6 × 6 cm. A few small Wormian bones present. The base of the skull is rather flat. Sella turcica normal. Inner ears sclerotic, and only slight pneumatization of the mastoid processes. Frontal and sphenoid sinuses absent and maxillary antra as well as ethmoid cells very small. Mandible small and angle flattened; right side fractured in region of angle; dentition very irregular.

Chest: very narrow; clavicles: slightly enlarged but rather short, the acromial ends not being fully developed. Vertebral bodies: short and 'reverse wedge-shaped'. Bones of the limbs: rather stumpy, those of the fingers being particularly short. Distal phalanges of the hands and feet shortened, most of them showing independent ossification of the ungual tuberosities which are detached from the phalanges proper. Pelvis including symphysis pubis normal. Pronounced bilateral coxa valga associated with subluxation; right femoral head: flattened; right femur and tibia show old transverse fractures; a good deal of callus present; both feet in varus.

The mandibular fracture did not heal owing to an atypical actinomycosis infection and a pseudarthrosis developed.

Discussion

As evident from the case histories, the two patients presented a large number of clinical and radiologic changes characteristic of cleidocranial dysostosis.

While in the first case there was no family history of the disease, a sister of the second patient was suffering from the same condition.

Both patients were of small stature and of peculiar appearance, the resemblance being striking. The shape of the head was characteristic, the square skull being in striking contrast to the small and narrow face with receding chin. The chest was narrow and the shoulders sloping. The extremities were stumpy and the fingers particularly short.

The radiologic findings may be divided into deficient ossification of the various skeletal parts and generalized osteosclerosis and bone fragility. The deficient and delayed ossification affects mainly the bones formed in membrane, both patients exhibiting pronounced defects in the theca cranii, persistence of sutures and fontanelles and the presence of Wormian bones. In addition, both presented slight shortening of the

acromial ends of the clavicles. Some of the bones formed in cartilage, however, also showed deficient ossification. The facial bones were poorly developed, the sphenoid and frontal sinuses absent, and the remaining accessory nasal sinuses small. There was greatly delayed eruption of the permanent teeth and abnormal dentition. The angle of the jaws was flattened. The chests were very narrow, and there was deficient development of the distal phalanges. In case 2 the vertebrae were 'reverse wedge-shaped'.

All these radiologic changes have been described in cleidocranial dysostosis. In our cases the clavicular defects were slight, but according to the literature they may range from total aplasia to minimal changes (SOULE, KRABBE).

Symphysial defects and coxa vara are fairly common findings (ELTORM), but were not present in our patients the second of whom, however, had coxa valga.

Generalized osteosclerosis was present in both cases, but most marked in the former; in this case the bone structure was almost obliterated, the bones exhibiting a marbled appearance.

In addition, both patients had a pronounced tendency to fractures, mainly of the lower limbs; Case 1 had sustained 11 fractures and Case 2 had had two of the lower limbs and one of the mandible. The causes had been slight, and the fractures must be interpreted as being pathologic. Without doubt, the tendency was due to osteosclerosis, the dense structure and the highly increased calcium content causing a fragility of the bone as in other skeletal disorders such as Paget's disease, in which sclerosis involves an increased risk of fracture.

Case 1 showed more marked osteosclerosis than Case 2 and had accordingly sustained more fractures.

Generalized osteosclerosis has not previously been reported as a feature of cleidocranial dysostosis; only ELTORM has mentioned bone sclerosis although in his case it was confined to the petrous portion of the temporal bone.

In our cases the real cause of the sclerosis was unknown. Since the serum calcium and phosphorus were normal in the first case (in which the sclerosis was most marked), a disturbance of the calcium metabolism did not seem likely. An examination of the formed elements of the blood revealed no abnormality, so the possibility of anaemia or other blood disorder as the causal factor may be ruled out. The presence of an additional generalized skeletal disorder is also improbable.

Pronounced sclerosis is observed in Albers-Schoenberg's disease, but the uniform distribution of the densities and the appearance of the bones, especially those of the extremities, in our cases did not resemble typical marble bones.

It is most likely therefore that the sclerosis represents a rare complication of cleidocranial dysostosis, caused by the same unknown factor as the disease proper.

SUMMARY

The authors describe two cases of cleidocranial dysostosis exhibiting a number of characteristic defects affecting bones formed in membrane as well as in cartilage and, in addition, marked generalized osteosclerosis resulting in fragility of the bones. This complication does not appear to have been described previously.

ZUSAMMENFASSUNG

Die Verf. beschreiben 2 Fälle von Dysostose cléido-cranienne, die eine Anzahl von karakteristischen Defekten aufweisen; es werden Knochen angegriffen, die sowohl aus Membranen als auch aus Knorpeln gebildet worden sind. Ausserdem zeigt das Skelett eine generalisierte Osteosklerose, die zu leichter Zerbrechlichkeit der Knochen führt. Diese Komplikation scheint bisher noch nicht beschrieben worden zu sein.

RÉSUMÉ

Les auteurs décrivent deux cas de dysostose cléido-cranienne qui présentaient un grand nombre de lésions caractéristiques des os, ceux-ci étant remplacés par des membranes ou par des cartilages. D'autre part le squelette en général était atteint d'ostéosclérose ce qui entrainait une grande fragilité des os. Cette complication ne semble pas avoir été décrite précédemment.

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FROM THE RADIUM CENTRE IN COPENHAGEN (DIRECTOR: JENS NIELSEN), DENMARK

THE VALUE OF PREOPERATIVE ROENTGEN IRRADIATION IN OPERABLE BREAST CANCER

by

Sigvard Kaae

Ever since HALSTED (13) and W. MEYER (19) described their technique of radical mastectomy, this operation has been generally recognized as the treatment of choice in operable breast cancer. Radiotherapy was introduced as a supplement to radical mastectomy shortly after Roentgen's discovery of roentgen rays in 1895. At the outset, radiation was given postoperatively (5, 21, 22, 23, 26), later preoperatively or both (2). To this day, there is a marked difference of opinion as to the value of radiotherapy as a supplement to radical mastectomy. Thus, NOHRMAN, WINDEYER and RICHARDS recommend preoperative roentgen irradiation in all cases and BULL ENGELSTAD postoperative radium therapy. ADAIR, ANDREASSEN and SAUGMANN-JENSEN & JACOBY found no difference between the results from preoperative and postoperative roentgen irradiation. BELL, CADE, HARNETT and LEDLIE have abandoned supplementary radiotherapy in early cases, but still use it in locally and regionally advanced cases. GORDON-TAYLOR, TAYLOR & WALLACE, and HAAGENSEN have completely abandoned supplementary radiotherapy in operable cases.

It has been attempted to improve the therapeutic results by altering the surgical procedure, reducing it to limited surgery supplemented by heavy postoperative roentgen irradiation or extending it to bigger operations. MCWHIRTER has reported satisfactory results following simple mastectomy followed by heavy roentgen irradiation, but as yet it is too

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early to assess the value of this method of treatment compared with radical mastectomy in operable cancer of the breast.

Others have tried to improve the results by extending radical mastectomy to comprise also removal of the supraclavicular nodes (DELBET, ANDREASSEN & DAHL-IVERSEN) or of the internal mammary lymphatic chain (WANGENSTEIN after HANDLEY & THACKRAY had pointed out the high incidence of metastases in the internal mammary lymphatic chain). The follow-up period is still too short to permit an evaluation of these extensions of radical mastectomy.

During recent years, moreover, the criteria of operability have been altered after HAAGENSEN & STOUT and PORTMANN pointed out that radical mastectomy, carried out in cases showing various signs of marked local progression, was practically speaking never followed by 5-year symptom-free survival. In 1943 HAAGENSEN & STOUT stated that radical mastectomy should not be performed: (1) when the carcinoma is one which developed during pregnancy or lactation, (2) when extensive oedema of the skin over the breast is present, (3) when satellite nodules are present in the skin over the breast, (4) when intercostal or parasternal tumour nodules are present, (5) when there is oedema of the arm, (6) when proved supraclavicular metastases are present, (7) when the carcinoma is of the inflammatory type, (8) when distant metastases are demonstrated. (9) when any two, or more, of the following signs of locally advanced carcinoma are present: (a) ulceration of the skin, (b) oedema of the skin of limited extent (less than one-third of the skin over the breast involved), (c) fixation of the tumour to the chest wall, (d) axillary lymph nodes measuring 2.5 cm, or more, in transverse diameter and proved by biopsy to contain metastases, (e) fixation of axillary lymph nodes to the skin or to the deep structures of the axilla and proved by biopsy to be the site of metastases. In 109 patients submitted to radical mastectomy despite the fact that they were inoperable according to these criteria, HAAGENSEN & STOUT reported 5-year symptom-free survival in only 3 cases, all of which developed recurrences and died shortly afterwards. In such instances, therefore, HAAGENSEN now prefers roentgen therapy, in some cases combined with minor palliative operations, such as simple mastectomy. But he has changed his opinion regarding carcinoma developing during pregnancy and lactation. Even if these cases have a poor prognosis, radical mastectomy should be performed in the absence of signs of marked local progression (11).

For the present, therefore, there is a marked conflict of opinion regarding the treatment of »operable» cases of breast cancer, applying both to the criteria of operability, the kind of surgical intervention to be performed, and the value of supplementary radiotherapy.

Writer's Material

During the period 1931—1944 the treatment of operable breast cancer at the Radium Centre in Copenhagen was preoperative roentgen irradiation and radical mastectomy, in some cases supplemented by postoperative roentgen irradiation. During all these years the surgical procedure has consisted in the removal *en bloc* of the breast with ample skin, both pectoral muscles, the axillary fat and lymph nodes. The operative indications were wide, all patients being considered operable if they did not exhibit carcinomatous tissue beyond the area removed at operation. Yet, inflammatory carcinomas were considered inoperable.

Supplementary radiotherapy, on the other hand, has undergone essential changes. During the period 1931—May 31, 1938 moderate preoperative roentgen irradiation was delivered to the breast and axilla and a small postoperative dose to the operative field, while during the period June 1, 1938 to 1944 a heavier preoperative dose was delivered to the breast, axilla, and supra-infraclavicular region, seldom followed by postoperative irradiation. During the first period the preoperative irradiation was directed at the breast through two tangential fields (dose in central part of breast about 1,600 r) and one field directed from below into the axilla (dose in central part of axilla about 800 r) in the course of eight days. The postoperative treatment consisted in tangential irradiation with a skin dose of about 1,000 r in the course of one or two weeks. During the second period the patients received preoperative tangential irradiation directed at the breast (dose in central part of breast about 3,500 r), one field directed from below into the axilla, and one field in the supra-infraclavicular region directed towards the axilla (dose in central part of axilla about 3,300 r and dose in supraclavicular region about 3,300) in the course of one month. It was endeavoured to perform radical mastectomy about one month after the completion of preoperative roentgen irradiation, but in some cases the interval was 2 or 3 months.

Diagram I sets out the symptom-free survival following preoperative roentgen irradiation and radical mastectomy, in some cases supplemented by postoperative roentgen irradiation, for the entire period 1931—44. The graph includes also 15 cases submitted to radical mastectomy at the Radium Centre without preceding roentgen irradiation. At the end of 5 years, 49 % of both stages were alive and symptom-free, without axillary metastases in 67 % and with axillary metastases in 30 %. At the end of 10 years, 32 % were alive symptom-free, without axillary metastases in 47 % and with axillary metastases in 18 % (no corrections have been made).

The supplementary preoperative roentgen irradiation differed considerably in the two periods. Since breast cancer is usually rather radio-

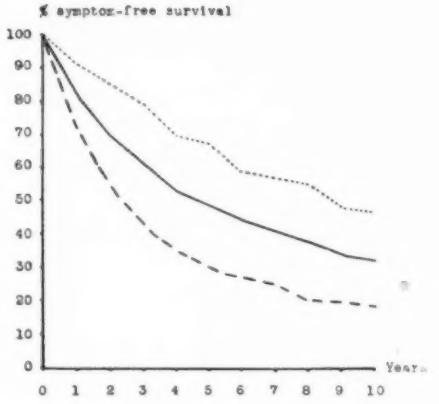

Diagram I. Symptom-free survival among 551 cases of breast cancer treated with preoperative roentgen irradiation and radical mastectomy, sometimes supplemented by postoperative roentgen therapy, during the period 1931 to 1944. The graph includes also 15 cases submitted to radical mastectomy without preceding irradiation at the Radium Centre.

resistant, better results and a lower incidence of local recurrence must be expected in the group receiving a heavier preoperative irradiation, if the latter has been of any value at all as a supplement to radical mastectomy.

Diagram II and Table 1 show a comparison of the results obtained during the period 1931 to May 31, 1938, during which moderate preoperative roentgen irradiation was administered, with those of the period June 1, 1938 to 1944 when a heavier preoperative roentgen irradiation was given. The results are better following heavy preoperative irradiation, particularly in the groups with histologically verified axillary metastases (Stage II) in which the 5-year symptom-free survival was 28 % following moderate preoperative irradiation as compared with 38 % following heavier preoperative irradiation. On the other hand, the two groups do not differ essentially with regard to the incidence of local recurrence in the operative field or of supraclavicular metastases on the operated side. The improved results following heavy preoperative roentgen irradiation are due to the more uncommon occurrence of distant metastases without local recurrence or supraclavicular metastases on the operated side.

Since the group treated with heavy preoperative roentgen irradiation includes a larger number of cases showing locally marked progression than the other group, Diagram III and Table 2 give the 5-year results from the 2 periods for those patients who should have been submitted, according to the criteria of HAAGENSEN & STOUT, to radical mastectomy. This also shows a better result following heavy preoperative roentgen irradiation, particularly in histological stage II (41 % as compared with 29 %): the difference is due exclusively to a

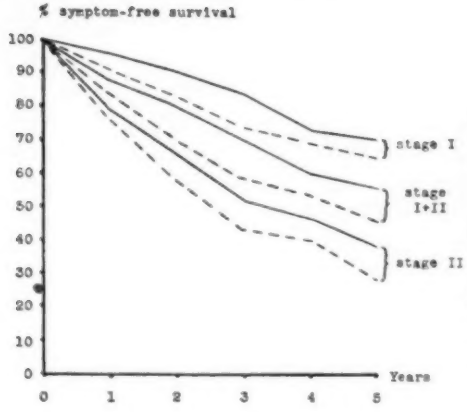

Diagram II. Comparison of the results following moderate preoperative roentgen irradiation/radical mastectomy/ postoperative roentgen irradiation in 108 cases (— — — —) and following heavy preoperative roentgen irradiation/radical mastectomy, sometimes supplemented by postoperative roentgen irradiation, in 332 cases (——) in primarily technically operable cases of breast cancer. Postoperative deaths are omitted.

Table 1

5-year results following heavy preoperative roentgen irradiation/radical mastectomy, in certain instances supplemented by postoperative roentgen irradiation (392 cases) and following moderate preoperative roentgen irradiation/radical mastectomy/postoperative roentgen irradiation (108 cases) in primarily technically operable cases of breast cancer. Postoperative deaths are omitted.

Histological stage	I + II		I		II	
Preoperative roentgen irradiation	heavy	moderate	heavy	moderate	heavy	moderate
Alive symptom-free	56 %	46 %	70 %	65 %	38 %	28 %
Died symptom-free	5.7 %	5.6 %	6.4 %	5.6 %	5.0 %	5.7 %
Local recurrence in operative field	9.6 %	9.3 %	5.9 %	7.4 %	14 %	9.4 %
Supraclavicular metastases and local recurrence	4.5 %	2.8 %	2.7 %	1.9 %	6.4 %	1.9 %
Supraclavicular metastases without local recurrence ..	4.2 %	2.8 %	2.7 %	0 %	6.4 %	5.7 %
Distant metastases without local recurrence or supraclavicular metastases	24 %	36 %	15 %	22 %	37 %	51 %

lower incidence of distant metastases without local recurrence or supraclavicular metastases on the operated side (in histological stage II 39 % as compared with 49 %). The difference is 1.2 × the mean error and is not statistically significant.

It will be seen, therefore, that the expected reduction in the incidence of recurrence within the radiated area (operative field and homolateral supraclavicular region) following heavy preoperative roentgen irradiation was not obtained. If the improved results in this group are due to the heavier preoperative roentgen irradiation, the only explanation is that

Diagram III. Symptom-free survival following preoperative roentgen irradiation/radical mastectomy, sometimes supplemented by postoperative roentgen irradiation in breast cancer. The figure gives the results obtained in cases which, according to the criteria of HAAGENSEN & STOUT, should have been treated by radical mastectomy — in 106 following moderate preoperative roentgen irradiation (— — —), and in 308 following heavy preoperative roentgen irradiation (———), and in the 26 technically operable cases which were incurable according to HAAGENSEN & STOUT (. . .). Postoperative deaths are omitted.

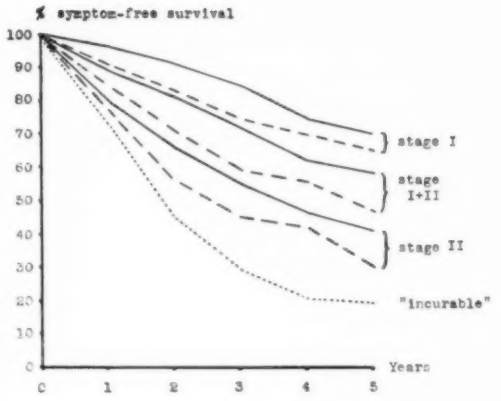

Table 2

5-year results following heavy preoperative roentgen irradiation/radical mastectomy, in some cases supplemented by postoperative roentgen irradiation (308 cases), and following moderate preoperative roentgen irradiation/radical mastectomy/postoperative roentgen irradiation (106 cases) in cases of breast cancer operable according to the criteria of HAAGENSEN & STOUT. *Postoperative deaths are omitted.*

Histological stage	I + II		I		II	
Preoperative roentgen irradiation	heavy	moderate	heavy	moderate	heavy	moderate
Alive symptom-free	58 %	47 %	70 %	65 %	41 %	29 %
Died symptom-free	5.9 %	5.7 %	6.6 %	5.6 %	4.9 %	5.9 %
Local recurrence in operative field	7.5 %	9.4 %	5.5 %	7.4 %	10 %	10 %
Supraclavicular metastases and local recurrence	2.9 %	2.8 %	2.2 %	1.9 %	4.1 %	2 %
Supraclavicular metastases without local recurrence ..	3.9 %	2.8 %	2.7 %	0 %	5.7 %	5.9 %
Distant metastases without local recurrence or supraclavicular metastases	25 %	35 %	15 %	22 %	39 %	49 %

the radiation has reduced the risk of dissemination of the breast cancer caused by manipulation during radical mastectomy. According to MCWHIRTER, this factor is of great significance. As mentioned above, however, the difference is not statistically significant.

In 42 cases incurable according to the criteria of HAAGENSEN & STOUT, radical mastectomy was performed following heavy roentgen irradiation. At the end of 5 years, 19 % were surviving symptom-free, 31 % had local recurrences, 21 % had supraclavicular metastases (accompanied by

local recurrences in 14 %), and 41 % had distant metastases without local recurrences or supraclavicular metastases. Only 9 out of these 42 patients have been followed up for 10 years, and of them only 1 has been symptom-free for over 10 years. (This patient had large supraclavicular metastases, proven histologically by trephine biopsy. The supraclavicular metastases yielded completely to preoperative roentgen therapy.) These results are appreciably better than HAAGENSEN & STOUT's following radical mastectomy alone. They reported 5-year symptom-free survival in only 2.8 % and local recurrence in 47.7 %. The better results obtained by us in the group inoperable according to the criteria of HAAGENSEN & STOUT by reason of local and regional progression must be due to the heavy pre-operative roentgen irradiation; in addition locally and regionally advanced cases (*e. g.* showing supraclavicular metastases, cutaneous metastases on the breast, large, fixed axillary metastases) were submitted to radical mastectomy only when preoperative roentgen irradiation was followed by pronounced, grossly visible subsidence of the tumour. Thus, during the period 1931—44, the Radium Centre in Copenhagen has treated a total of 205 patients with breast cancer inoperable (from the criteria of HAAGENSEN & STOUT owing to local and regional progression) but without demonstrable distant metastases. Therefore, the 42 cases submitted to radical mastectomy following heavy roentgen irradiation with grossly visible effect make up only about 20 %. Among the total number of 205 cases only 10 % were alive at the end of 5 years and only 3.9 % were symptom-free. Accordingly, the 5-year results for the whole group are on a level with those reported by HAAGENSEN & STOUT, and the better results in the small group of 42 patients are apparent only when regarded separately.

Conclusions

Heavy preoperative roentgen irradiation supplementary to radical mastectomy does not appear to afford better results than moderate preoperative roentgen irradiation in definitely operable cases (operable according to the criteria of HAAGENSEN & STOUT). At any rate, it has not lowered the incidence of recurrence in the radiated area. Since breast cancer on the whole is rather radio-resistant, it is questionable, whether anything has been gained by supplementing radical mastectomy by preoperative roentgen irradiation in the cases operable according to the criteria of HAAGENSEN & STOUT.

In locally and regionally advanced cases (categorically inoperable according to HAAGENSEN & STOUT), the results of radical mastectomy may sometimes be improved by initiating the treatment with heavy preoperative roentgen irradiation. This group, however, is small, and

the improvement obtainable appears to amount to merely a few per cent in the 5-year results for all »operable» cases. It is therefore doubtful, whether systematic preoperative roentgen irradiation ought to be continued as a supplement to radical mastectomy in all operable cases.

SUMMARY

After a brief review of the literature, the writer reports his own results from preoperative roentgen irradiation/radical mastectomy, in certain instances supplemented by postoperative roentgen irradiation, in cases of operable breast cancer treated at the Radium Centre in Copenhagen during the period 1931—1944. Comparing the results following moderate and appreciably heavier preoperative roentgen irradiation, the writer arrives at the conclusion that preoperative roentgen irradiation does not appear to be valuable as a supplement to radical mastectomy except in locally and regionally advanced cases.

ZUSAMMENFASSUNG

Nach einem kurzen Überblick über die Literatur berichtet der Verf. eigene Resultate mit präoperativer Röntgenbehandlung/radikaler Mastektomie, in gewissen Fällen ergänzt mit postoperativer Röntgenbehandlung, bei operablen Brustkrebsfällen, die während der Jahre 1931—1944 im Radiumzentrum in Kopenhagen behandelt wurden. Die Ergebnisse mässiger und ziemlich intensiver präoperativer Röntgenbehandlung wurden verglichen; dabei ergab sich, dass die präoperative Röntgenbehandlung als Supplement zur radikalen Mastektomie nicht wertvoll zu sein scheint; eine Ausnahme bilden lokal und regionär weit vorgeschrittene Fälle.

RÉSUMÉ

L'auteur résumé brièvement la littérature, puis expose les résultats qu'il a obtenus avec la roentgenthérapie préopératoire/mastectomie radicale, complétée dans certains cas par roentgenthérapie postopératoire. Son matériel se compose des cas opérables de cancer du sein traités au Centre du Radium de Copenhague, durant la période 1931—1944. En comparant les résultats obtenus, d'une part, après une irradiation préopératoire modérée, et d'autre part, après une irradiation préopératoire considérablement plus forte, l'auteur arrive à la conclusion que l'irradiation préopératoire par les rayons roentgen ne semble pas être de nature à apporter une aide sérieuse dans la mastectomie radicale, excepté dans les cas localement et régionalement avancés.

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FROM RADIUMHEMMET (DIRECTOR: PROF. H. AHLBOM), STOCKHOLM, SWEDEN

INTERNAL TREATMENT OF MYCOSIS FUNGOIDES WITH P^{32}

by

Lars-Gunnar Larsson

When P^{32} in the form of a soluble phosphate is administered to a patient with a malignant disease, a relatively high uptake of the radioactive isotope in the lesions often occurs on account of the high metabolic activity of the malignant tissue. P^{32} is a pure beta-emitter and the irradiation has a maximal range in the tissue of 7—8 mm. When the lesions are superficially situated in the body, it is possible to estimate roughly the relative uptake of the isotope with a Geiger-Müller tube, this method first being applied by MARINELLI and GOLDSCHMIDT (1942) who reported results in two cases of mycosis fungoides and one case of malignant melanoma. In all the cases there was a relatively high uptake of P^{32} in the lesions and in the two cases of mycosis fungoides the lesions exhibited activities 20 and 7 times those of the normal skin.

The lesions of mycosis fungoides are usually very radiosensitive and it seems possible that the internal administration of P^{32} may be of therapeutic value. In the report of MARINELLI and GOLDSCHMIDT the clinical course of the cases was incompletely described. They mentioned, however, that some of the lesions showed definite regression in spite of rather low dosage. LOW-BEER et al. treated 5 cases of mycosis fungoides with P^{32}. Two failed to respond and two had temporary remissions. The dosage in these four cases was not mentioned. The fifth patient had a deep, ulcerating tumour of the breast. She received five intravenous injections of P^{32} totalling 27 millicuries over a seven-week period and the lesion was at the same time treated with external applications of radiostrontium. Complete healing was obtained and the patient was still free from signs seven years after treatment. It is of course difficult to judge to what extent the result depended upon the internal or the external treatment.

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Fig. 1. Case 1. May 9. 1951; before P^{32} treatment.

Fig. 2. Case 1. July 21. 1951; six weeks after the last dose of P^{32}.

During the last year two cases of mycosis fungoides were treated at Radiumhemmet with P^{32}. In both cases remissions occurred and in one of the cases the palliation was very remarkable.

Case 1. 2653/51. A. G. E. K. Male, 56 years old; for 10 years had had widespread, superficial infiltration; during the previous 5 years the lesions covered the greater part of the skin surface. The disease was slowly progressing; during latter years deeper, ulcerating lesions also developed on the trunk and the legs. He was treated in October 1950 with penicillin and in March 1951 with chloromycetin without significant improvement. Microscopical examination revealed signs of mycosis fungoides.

When first examined at Radiumhemmet on May 7, 1951 he was in a rather bad general condition. Practically the whole skin surface was covered with superficial, reddish, scaling infiltrations (Fig. 1). In addition, there were also deeper, ulcerating, more tumour-like changes; the largest was situated in the anterior part of the left axilla (Fig. 3).

He was given the following doses of P^{32} orally: May 8, 10 mC; May 11, 3 mC; May 17, 5 mC; May 23, 4 mC; June 1, 4 mC and June 6, 4 mC; the total dose was 30 mC. After 2—3 weeks of treatment the superficial lesions began to diminish and become paler and more scaling than previously; the deeper, tumour-like infiltrations also diminished during the treatment. On June 6, measurements with a G.-M. tube were carried out. It was not possible to find an area of normal skin for comparison. Measurement on a marked lesion, however, gave counting-rates 3 times higher than those obtained from a skin area with only very slight changes. By reason of the fact that the measurements were made at a late stage of the treatment when a definite therapeutic effect had already been obtained, and because the control skin area was not quite normal, it is probable that the

Fig. 3. Case 1. June 8. 1951; at the end of P^{32} treatment.

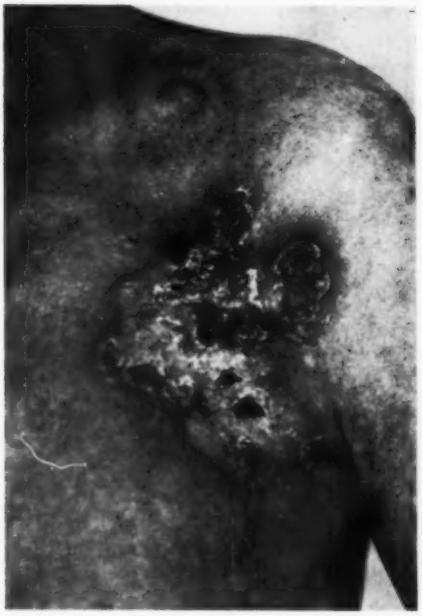

Fig. 4. Case 1. July 21. 1951; six weeks after treatment.

initial differential uptake in the lesions was considerably higher than indicated by the figures.

On June 15, the patient returned to his home. When he came back to the hospital on July 20, there was a remarkable regression of all the lesions. The generalized superficial lesions had disappeared (Fig. 2) and there was also a marked regression of the deeper, ulcerating lesions which had partly healed (Fig. 4). Three of the latter lesions which were not quite healed were given local roentgen treatment in July and Sept. 1951. The skin has since been in very good condition with only slight residues; the last control was on Nov. 26.

The general condition of the patient improved during and after the treatment and from May till November 1951 he gained 9 kg in weight. The sedimentation rate before treatment was 80 mm/hour and at the last control 4 mm/hour.

The reaction of the blood picture is illustrated in Fig. 5. At the end of the treatment there was a drop in the W. B. C. and a thrombocytopenia. The red blood picture was slightly depressed during the treatment but later raised above the initial level. At the last controls the blood counts were normal, with the possible exception of a slight leucopenia.

Case 2. 4270/51. P. H. N. Male, 71 years old; for two months rapidly growing nodules had developed on the body. The microscopical picture corresponded to mycosis fungoides. When first seen at Radiumhemmet on July 23, 1951 he had scattered, bluish-

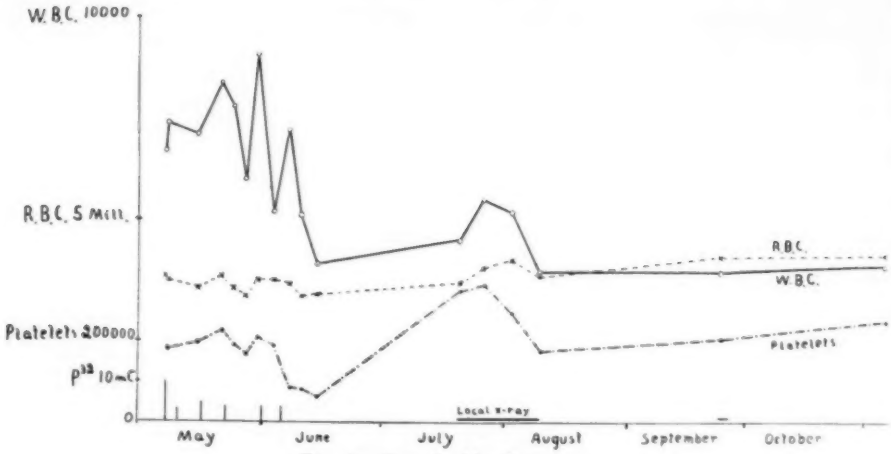

Fig. 5. Case 1; blood counts.

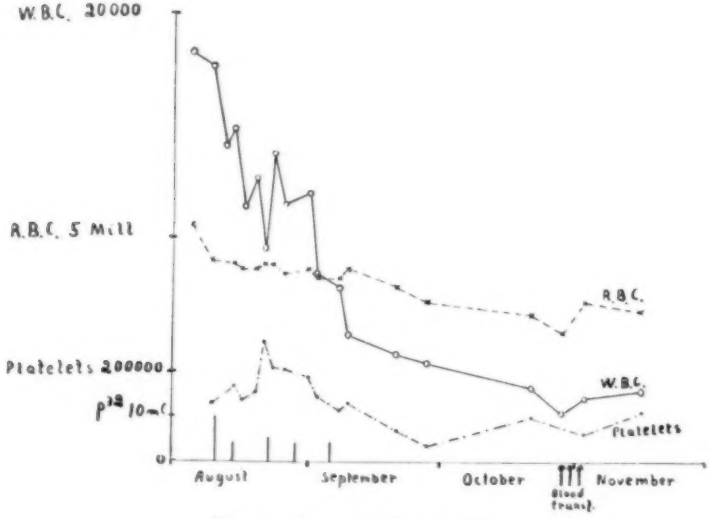

Fig. 6. Case 2; blood counts.

red infiltrations of varying size over the whole body. A large infiltration on the back was treated by roentgen; no other local treatment was given.

He received the following doses of P^{32} orally: August 11, 10 mC; Aug. 15, 4 mC; Aug. 23, 5 mC; Aug. 29, 4 mC and Sept. 6, 4 mC; the total dose was 27 mC. On August 16 measurements with G.-M. tube were performed. The lesions exhibited activities 7—10 times those of the normal skin. During the treatment there was a marked regression of the lesions, many of which disappeared completely, the larger diminishing in size with

wrinkling of the covering skin. Some weeks after treatment, however, the infiltration commenced again and fresh lesions appeared. The progression of the disease from then was quite as rapid as before the treatment.

The general condition improved during treatment but later again deteriorated in association with the rapid progression of the disease. The reaction of the blood picture is illustrated in Fig. 6. There was a remarkably high W. B. C. (18, 300) before treatment. Examination of blood and bone marrow smears, however, revealed no signs of leukemia. During and after the treatment there was a marked drop in both the R. B. C. and W. B. C. and there was also a thrombocytopenia. Because of the anemia three blood transfusions were given at the end of October. At the last control on Nov. 16, 1951 the following blood values were found: Hbg 68 %, R. B. C. 3.4 mill., W. B. C. 3,200, thrombocytes 113,000.

Discussion

By reason of the fact that the lesions of mycosis fungoides show a relatively high uptake of phosphorus and are usually very radiosensitive, it seems possible that internal treatment with P^{32} may be of value in this disease. In the two advanced cases reported, remissions occurred and the first patient obtained considerable benefit from the treatment. It must be pointed out, however, that the amounts of P^{32} administered in both cases were unusually large and probably lay near the absolute tolerance level. Such large amounts are probably necessary if a pronounced effect on the lesions be desired. By serial measurements over the lesions and by measuring the radioactivity in biopsy specimens MARINELLI and GOLDSCHMIDT estimated the irradiation dose in the lesions in their two cases to be about 1.3—1.5 rep, when one microcurie per kg of body weight was administered. If we assume that the uptake in our cases was roughly of the same magnitude, the irradiation dose in the lesions would be about 500 rep, delivered over several weeks. This irradiation dose is rather low and it seems improbable that essentially lower doses would cause significant regression.

Because of the very good palliation obtained in the first patient internal treatment with P^{32} seems justified in similar cases, *i. e.* cases with slowly progressive, very wide-spread infiltrations mainly of the premycotic type; this is especially true as no other effective treatment exists for such conditions. The dosage must of course be an individual one depending upon the body weight of the patient and the early response of the blood picture. It must be emphasized that treatment with P^{32}, as all other existing treatment of mycosis fungoides, is only palliative. Because of the risk of serious damage of the hematopoesis, there therefore appears to be no justification for administering P^{32} internally in cases only presenting a few lesions. For such cases local radiotherapy is probably preferable.

SUMMARY

Two advanced cases of mycosis fungoides with wide-spread lesions were treated with unusually large doses of P^{32}. In both cases remissions occurred and in one the palliation obtained was extremely satisfactory.

ZUSAMMENFASSUNG

Zwei weit fortgeschrittene Fälle von Mykosis fungiformis mit ausgedehnten Veränderungen wurden mit ungewöhnlich grossen Dosen von radioaktivem Phosphor (P^{32}) behandelt. In beiden Fällen traten Remissionen auf und in einem Falle war die erreichte Palliation ausserordentlich zufriedenstellend.

RÉSUMÉ

Deux cas avancés de mycosis fungoïde présentant des lésions étendues furent traités par des doses inhabituellement élevées de P^{32}. Une remission se produisit dans les deux cas, et dans l'un l'effet palliatif obtenu fut extrêmement satisfaisant.

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FROM THE ROENTGEN DEPARTMENT (DIRECTOR: PROFESSOR A. DRUCKMANN), HADASSAH UNIVERSITY HOSPITAL, JERUSALEM, ISRAEL

HIGH RENAL ECTOPIA, DETECTED ON ROUTINE CHEST EXAMINATION

Case report

by

A. Schwartz and *M. Fränkel*

Only six cases of high renal ectopia, producing shadows extending partly above the diaphragm are reported in recent literature. Four of these were diagnosed on roentgen examination (three on the left, one on the right side) (1, 2, 7, 8), while in the other two (5, 6), thoracotomy revealed the true condition.

Because of the rarity of the condition, and the possible diagnostic implications, it seems worthwhile to report the following case.

Case report

R. Ch., a 65-year-old housewife (married; multipara) was admitted to hospital with anemia, jaundice and enlargement of the spleen and liver. On examination of the chest, a rounded massive opacity on the medial-posterior aspect of the left diaphragm was observed. (Fig. 1 & 2.) It moved slightly with the respiratory excursions of the diaphragm. The shadow did not contain gas. Its position — medial and posterior — suggested the possibility of it being part of the left kidney. In order to prove this assumption a nephrogram with 50 cc Diodrast »Winthrop» 70 %, in order to render the whole kidney opaque, was carried out. This showed that the upper part of the left kidney corresponded with the shadow above the diaphragm in the plain PA radiogram, thus confirming the diagnosis. The urography (fig. 3), showed the upper calyx in the protruded part of the left kidney.

A gastro-intestinal tract examination, including a barium enema, revealed normal conditions.

Conclusions

When a rounded shadow, not containing gas, is noted on the medial-posterior aspect of the diaphragm, the possibility of it being part of the kidney should be first excluded before other investigations are carried out.

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Fig. 1. Rounded shadow behind the heart, and above the left hemi-diaphragm.

Fig. 2. Rounded mass, not containing gas, overshadowing the spine.

Fig. 3. Urography: the upper calyx of the left kidney in the protruding shadow.

SUMMARY

A case of high ectopia, suspected on examination of the chest, is reported. The diagnosis was confirmed by means of urography.

ZUSAMMENFASSUNG

Ein Fall von hoher Ektopie, der bei der Untersuchung des Thorax vermutet wurde, wird beschrieben. Die Diagnose wurde durch eine Urographie bestätigt.

RÉSUMÉ

Description d'un cas d'ectopie haute du rein, soupçonnée par la radiographie du thorax et confirmé par l'urographie.

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BOOK REVIEW

KYMOGRAPHISCHE RÖNTGENDIAGNOSTIK ZUR BEURTEILUNG DES HERZENS IN BEISPIELEN. Von Pleikart Stumpf. 120 Seiten, 164 Abb. Georg Thieme Verlag, Stuttgart 1951. DM 25: 50.

This work is a continuation of the publication of 1936 by the same author in collaboration with WEBER and WELTZ entitled »Kymographische Bewegungslehre innerer Organe» and consists of a description of the roentgenkymographic changes in various diseases of the heart.

A survey of the methods of examination and of the cardio-dynamic foundations for roentgenkymography is followed by a description of normal cases.

The section of pathologic changes begins with acquired valvular defects. There are many gradations of such changes and as far as the reviewer can understand, difficult to gauge. One gains the impression that roentgenkymography is obviously inferior to electrokymography at least as far as these diseases are concerned, thanks mainly to the precise registration of the time relationships in the latter method. Thus, of kymography in aortic insufficiency the author states (p. 18) »eine hohe Zacke, die offenbar der Umformung bei der Anspannung entspricht». It can unmistakably be confirmed by electrokymography that this »Zacke» occurs during the commencement of the systolic ejection. Systolic expansion of the left auricle in mitral insufficiency can serve as a further example. It is definitely registered by electrokymography but to judge from the description in this work is more difficult to record by roentgenkymography; in any case it is not mentioned in this connection by the author.

In a number of cases of myocardial injuries including infarctions, descriptions are given of paradoxical movements of the ventricle, breaking up of the ventricular curves during diastole and locally diminished or inhibited movements. In connection with aborted extra systoles, the theory is advanced that contractions in the diseased myocardium can occur only in part of the heart muscle. The author considers that an increase in the residual blood creates a so-called »Rückstosszacke» in the kymograph, that is to say, a lateral and medial movement immediately following the end of systole. The same phenomenon however might also occur in goitre, hypertension, and in what is called contractile dysfunction. Especially in the latter condition as well as in other connections, the value of kymography following physical work is stressed.

Regarding the question of aortic aneurysms, the author emphasizes that these cannot be excluded by the absence of pulsations but considers it possible to estimate the degree of thrombosis from the nature of the pulsations.

In connection with the condition of concretio pericardii, it is shown how the heartbeats become more regular and have greater amplitude after decapsulation. Finally the author presents cases with metal splinters in various parts of the heart muscle, as well as just extra-cardially, in which the bodies show characteristic movements according to their situation.

It may be said in conclusion that a roentgenkymographic diagnosis of the heart as described in the book reviewed, embraces flora, in many cases, richly detailed with variable and indefinite changes. Anyone, not possessing the great experience of the author, might easily be tempted into subjective judgements.

Ture Andersson.